TECHNICAL MEMORANDUM

WATER QUALITY ANALYSIS IN THE WATER CONSERVATION AREAS 1978 AND 1979

INTERIM PROGRESS REPORT

DRE 121

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Introduction

The purpose of this Technical Memorandum is to report on the progress of two of the Division of Water Chemistry's current projects: Conservation Area Material Budget (8644) and the Conservation Area Water Quality (8630). Both of these water quality monitoring programs were designed in 1977 and implemented January 1, 1978. The entire study will encompass three years; the first two, 1978 and 1979, will be reviewed in this interim report. This assessment of chemical and hydrological data will include inflow/outflow and interior water qualities and budgetary analyses. A final report will be completed in the summer of 1981.

Purpose and Objectives

The purpose of this three year study is to document the quality of water within and entering the Water Conservation Areas. More specifically, the goals are to:

(1) Monitor all surface inflows and outflows and develop a materials budget.

(2) Create a data base contingent upon present endemic water quality and current water management practices.

(3) Monitor changes in water quality over time in reaction to variations in the volume of surface water inflows and rainfall.

(4) Map the areal distribution of water quality parameters within the Water Conservation Areas during varying pumping regimes.

The data collected and conclusions formed as a result of this study will not only provide the District with baseline data for the Water

Conservation Areas but also provide an indication of the cause/effect relationship between the quality of the inflows and its impact on the resultant water quality in the Water Conservation Areas. This information may also be used as input to other District programs which are currently investigating the shifts in indigenous periphyton colonization in response to changes in Water Conservation Area inflow quality. This overall assessment will provide a better understanding as to the environmental impact water management practices will have on the ecology of the Water Conservation Areas.

The five Water Conservation Areas (Figure 1) are characterized by an expanse of enclosed marsh encompassing almost a million acres of native Florida wetlands covering parts of Dade, Broward, and Palm Beach Counties. The network of canals, levees, and hydrologic gates and pumps which encircle the system allow the manipulation of water levels within and throughout these areas. This hydrologic control allows the orderly release of excess water to the coast during wet conditions and impoundment of water for use during the dry season.

Vegetatively, the Water Conservation Areas (WCA's) are characterized primarily by a marsh community of sawgrass (Cladium jamacensis), cattail (Typha sp.), lily (Nymphaea odorata) and bladderwort (Utricularia sp). Areas 1 and 3 are also characterized by occasional tree islands, which are slightly elevated and populated by a variety of herbaceous shrubs and hardwoods; however, in WCA 2A the unusually high water levels have drowned out the natural tree islands and given way to a permanent assortment of deeper water plants.

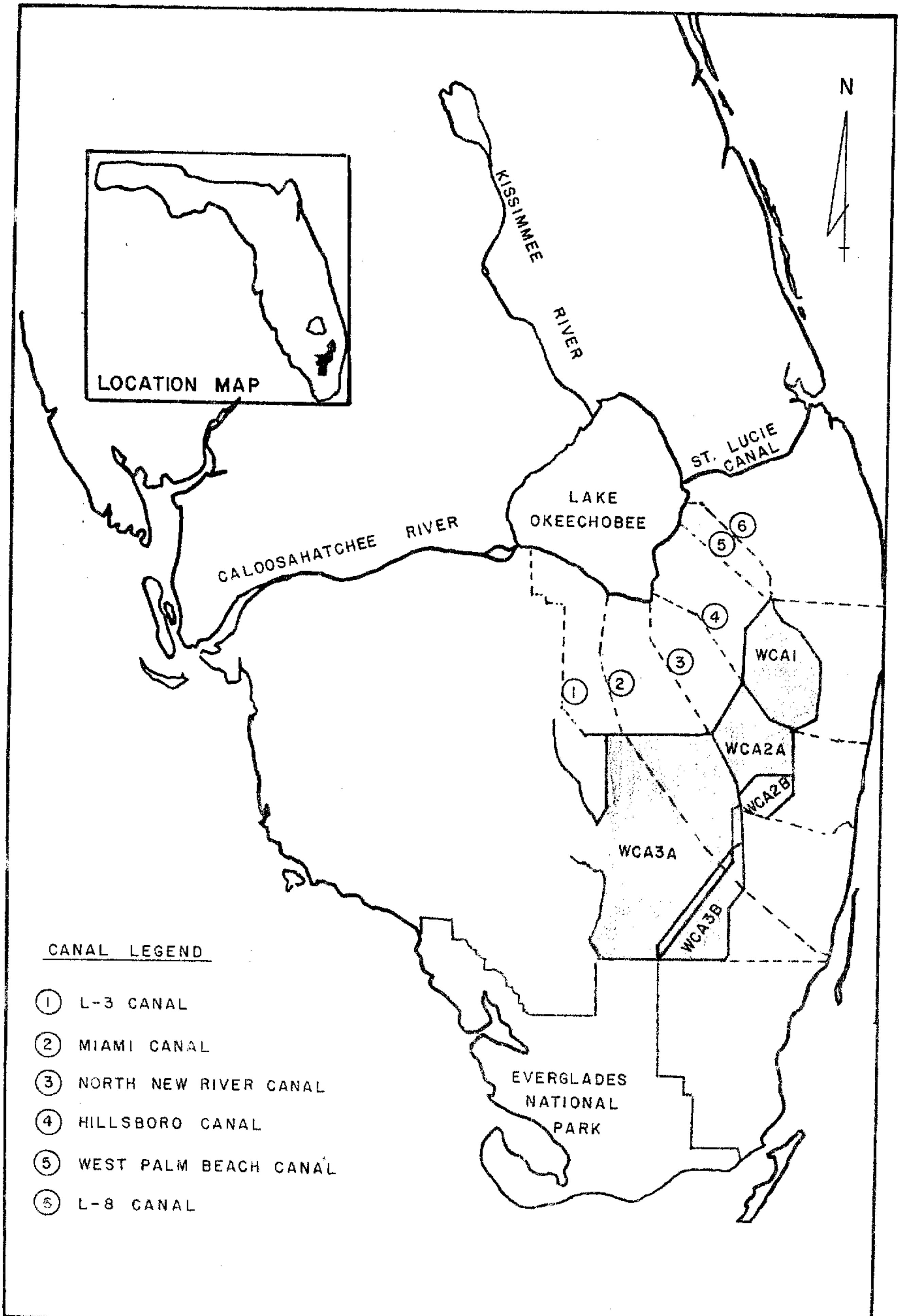


FIGURE 1. THE WATER CONSERVATION AREAS

The Water Conservation Areas provide a multipurpose service. The water retention abilities of the areas provide a fresh water supply to meet the agricultural, industrial, and municipal demands of south Florida. The areas also provide other, equally important, services; flood protection, groundwater recharge, recreation, and wildlife preservation.

Geographically, 49% of the original Everglades marsh lies within the Water Conservation Areas. In addition, an integral function of the Water Conservation Areas is as a supplier of water to the Everglades National Park. Therefore, the maintenance of water quality within the Water Conservation Areas is not only important to south Florida's future demands for a high quality, high volume water supply but also crucial to the ecology of one of the nation's unique national parks.

This study focuses on the three main Water Conservation Areas:

Water Conservation Area 1	-	221 sq. miles or 141,440 acres
Water Conservation Area 2A	-	173 sq. miles or 110,730 acres
Water Conservation Area 3A	-	786 sq. miles or 503,040 acres
		1,180 sq. miles or 755,200 acres

The 755,200 acres represents 88% of the total land covered by the Water Conservation Areas. The other 12% is made up of WCA 2B (23,670 acres) and WCA 3B (81,920 acres) which were not included in this study.

Water Conservation Area 1 (WCA 1) - Water Conservation Area 1 is of the northernmost pool of the modified wetlands system. It is made up of a relatively shallow marsh encircled by a rim canal of 3 to 4 meters deep. During periods of low stage levels in WCA 1, water pumped into the area via one of the Area 1 structures will, in general, flow south along the perimeter canal and avoid the higher ground at the center of WCA 1. Under these conditions the water quality at the center of the area reflects that of rainfall; however, as the stage levels increase the amount of penetration of discharge waters also increases from perimeter pumps, resulting in an increased effect on the entire Water Conservation Area 1.

In all there are five inflow structures and five outflows. Two of these inflows, pump stations S5A and S6, drain the Everglades Agricultural Area (EAA) and contribute the majority of the surface input to WCA 1. The other three inflows are privately owned structures and are operated under District permits. The L7 pump station is owned and operated by the S.N. Knight Sugar Corporation and pumps into WCA 1 at the NW edge. The Acme Drainage District operates the other two private pumps (L40-1 and L40-2) on the NE edge. Exact discharge rates and schedules for these private pumps are unavailable at this time, but compared to S5A, S5, and rainfall the total input of these three private stations is relatively minor.

Water Conservation Area 2A (WCA 2A) - Water Conservation Area 2A, the smallest of the three study areas, lies to the southwest of WCA 1 and northeast of WCA 3A. Parts of the perimeter canal, especially on the west and south sides, are well defined; however, the perimeter canal is not uniformly continuous and thus the area exhibits both perimeter and sheet flow. Surface inflows can come either from the S7 pump station, which similar to S5A and S6 drains the Everglades Agricultural Area to the north, or from the S10 structures which convey water from WCA 1 and WCA 2A via gravity discharge. In turn, water can be discharged out of WCA 2A through either the S38 structure to the east, S144, S145 and S146 to the south, or the S11 structures to the west.

Presently there is an interest in drawing down the stage levels in WCA 2A to help repopulate this area with indigenous wet prairie vegetation.

Water Conservation Area 3A (WCA 3A) - Water Conservation Area 3A is over twice the size of WCA 1 and WCA 2A combined. This area is predominantly a marsh community with an extensive cypress stand on the west side extending from the L28 interceptor south to the Tamiami Trail.

In general, the inflow points at the north end (L3, S8, S150) drain runoff from agricultural origins. The S9 structure pumps predominantly urban runoff of the South New River Canal. The L28E and S140 drainage basins represent relatively "natural" wetlands to the west of WCA 3A.

MATERIALS AND METHODS

The frequency and method of data collection differed from the interior study as compared to the inflow/outflow points.

Inflow/Outflow Sampling - The majority of the inflows/outflows (Figure 2) (Table 1) were sampled every two weeks (Table 2). Nine of the stations: S10A, S10C, S10D, S11A, S11B, S11C, S144, S145, and S146 were sampled only if they had been discharging at any time during the preceding two week period. In addition to a biweekly sampling, four of the major pump stations - S5A, S6, S7, and S8 were also sampled automatically using a flow proportional Quality Control(R) automatic sampler. Tables 3 through 5 provide a detailed description of the purpose of each of the inflow/outflow structures.

Figure 2 THE WATER CONSERVATION AREAS INFLOW/OUTFLOW SAMPLING STATIONS

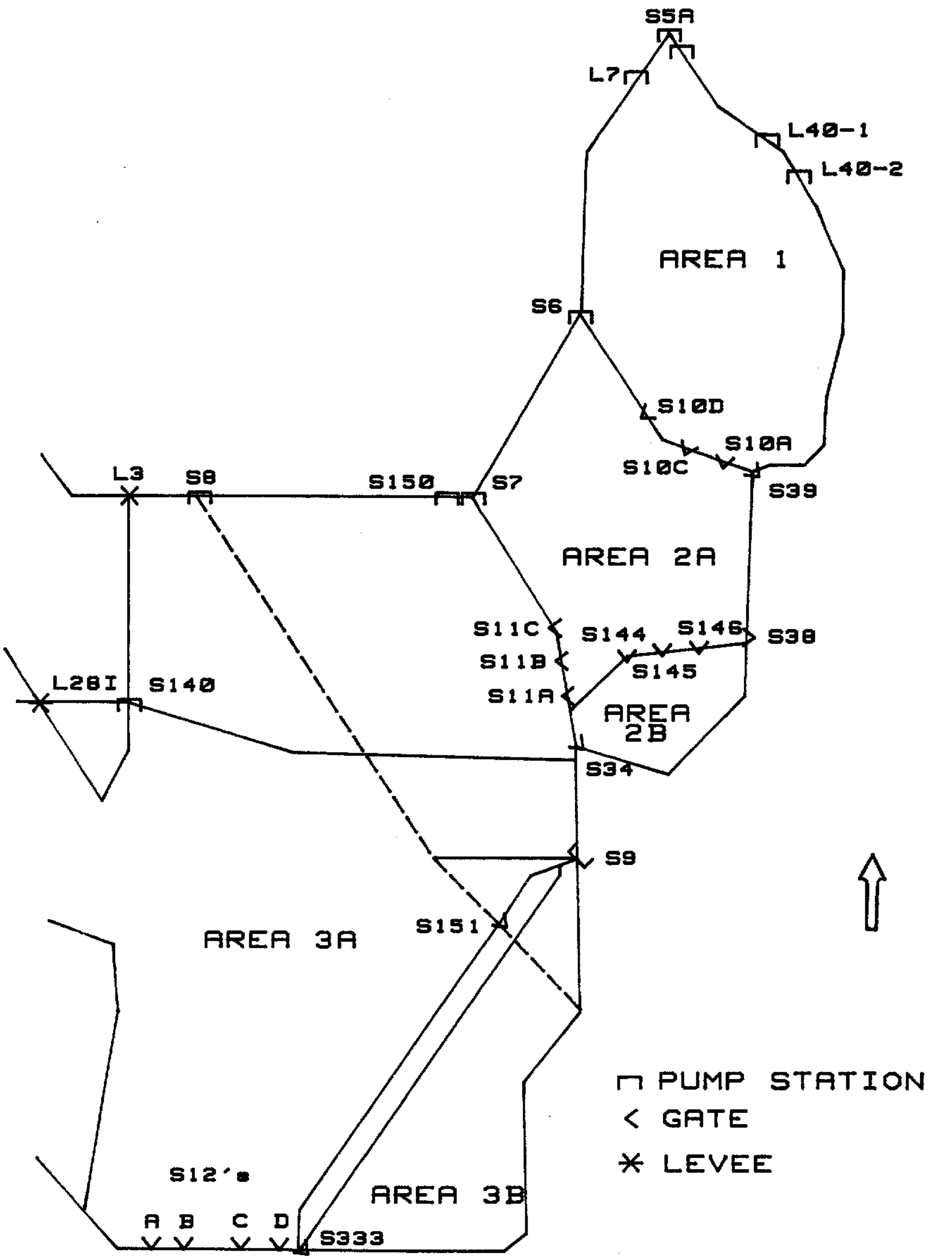


TABLE 1

INFLOW/OUTFLOW SAMPLING SITE LOCATIONS

Station Code	Location
S5A	north side of the pump station
S6	" " " "
S7	" " " "
S8	" " " "
S5AS	west side of structure
L40-1	west side of the pump station
L40-2	" " " "
L7	" " " "
S39	west side of the structure
S150	north side of the structure
S10A *	Conservation Area 1 side of the structure
S10C *	" " " "
S10D *	" " " "
S11A *	Conservation Area 2A side of the structure
S11B *	" " " "
S11C *	" " " "
S34	north side of the structure
S9	east side of the structure
S151	Conservation Area 3A side of the structure
S12A	north side of the structure
S12B	" " "
S12C	" " "
S12D	" " "
S333	west side of the structure
L28I	off the Alligator Alley bridge
S140	west side of the structure
L3	sample taken from canal bank downstream of Oilwell bridge
S144 *	Conservation Area 2A side of the structure
S145 *	" " " "
S146 *	" " " "
S38	" " " "

* Sampled only if discharge occurred within period of time two weeks prior to sampling date

TABLE 2 SAMPLING DATES

1978:	Inflow/outflow	Interior
January	4 & 5, 17 & 18	
February	1 & 2, 14 & 15	
March	1 & 2, 14 & 15, 28 & 29	
April	12 & 13, 25 & 26	
May	9 & 10, 23 & 24	15 & 16
June	7 & 8, 19 & 20	29 & 30
July	5 & 6, 17 & 18	
August	1 & 2, 14 & 15, 29 & 30	3 & 4
September	11 & 12, 25 & 26	
October	9 & 10, 23 & 24	26 & 27
November	6 & 7, 20 & 21	
December	4 & 5, 18 & 19	8 & 12
1979:		
January	2 & 3, 15 & 16, 30 & 31	
February	12 & 13, 26 & 27	
March	12 & 13, 26 & 27	28 & 29
April	9 & 10, 23 & 24	
May	7 & 8, 21 & 22	23 & 24
June	4 & 5, 18 & 19	21 & 22
July	2 & 3, 16 & 17, 30 & 31	
August	14 & 15, 28 & 29	29 & 30
September	10 & 11, 25 & 26	
October	8 & 9, 22 & 23	25 & 26
November	5 & 6, 19 & 20	
December	3 & 4	

TABLE 3 DESCRIPTIONS OF WATER CONSERVATION AREA 1 STRUCTURES

Inflows	
S5A	Pumps agricultural runoff from the 230 square mile area served by the West Palm Beach Canal
S6	Removes excess water from the 146 square mile portion of the Everglades Agricultural Area served by the Hillsboro Canal
L7	Privately maintained and operated by S. N. Knight Refineries for the purpose of emptying their drainage canals into Water Conservation Area 1
L40-1 and L40-2	Twin pump stations operated by Acme Drainage District in order to drain urban developments
Outflows	
S5AS	Gravity flow from Water Conservation Area 1 with C-8 tieback canal
S39	Gravity flow into Hillsboro Canal
S10A, S10C and S10D	Three gravity gates which control the transfer of water from Water Conservation Area 1 to Water Conservation Area 2A

TABLE 4 DESCRIPTIONS OF WATER CONSERVATION AREA 2A STRUCTURE

Inflows	
S7	Removes water from the 125 square mile portion of the Everglades Agricultural Area served by the North New River Canal
S10A, S10C, S10D	Transfer of water from Water Conservation Area 1 to Water Conservation Area 2A
Outflows	
S38	Drains Water Conservation Area 2A to the east via the C-14 Canal
S144, S145 and S146	Transfer of water from WCA 2A to WCA 2B
S11A, S11B, S11C	Transfer of water from WCA 2A to WCA 3A
S34	Structure used to bypass WCA 2B and discharge WCA 2A water directly into North New River Canal

TABLE 5. DESCRIPTIONS OF WATER CONSERVATION AREA 3A STRUCTURE

<u>Inflows</u>	
S150	Gravity gate which drains portions of the Everglades Agricultural Area into Water Conservation Area 3A
S8	Control of water levels in the 208 square mile portion of the Everglades Agricultural Area served by the Miami Canal. Water is pumped directly into the Miami Canal which in turn diffuses with WCA 3A
L3	The transfer canal by which water is carried from the western extent of the Everglades Agricultural Area into WCA 3A
L28I	Represents the discharge of S190 down the C28 canal
S140	Control of water levels in the 110 square mile drainage area served by the Levee 28 Borrow Canal and Levee 28 Interceptor Canal
S11A, S11B, S11C	Transfer of water from WCA 2A to WCA 3A under State Road 27
S9	Control of water levels in the 71 square mile drainage area served by the South New River Canal
<u>Outflows</u>	
S151	Gravity gate designed to transfer water from WCA 3A to WCA 3B via the Miami Canal
S333	Gravity gate utilized for the discharge of WCA 3A water eastward into the C-29 Canal
S12A, S12B, S12C, S12D	Four gravity flows responsible for the discharge of WCA 3A water into the Everglades National Park

In situ field parameters (temperature, dissolved oxygen, specific conductance and pH) for the inflow/outflow sites were recorded utilizing a Hydrolab(R) Surveyor II or Hydrolab 8000(R). Hydrolab readings were taken at the surface and at one meter intervals to the maximum depth of the sample site. All water samples were collected from the surface in a polyethylene bucket. Also during each sampling trip a set of triplicate water samples were collected from a random site for the purpose of quality control.

Interior Sampling - The 68 stations which comprise the interior water sampling program were sampled several times during each study year in order to collect data during different seasonal and hydrological conditions. Fifty-eight of these stations were collected from a polyethylene water sampler suspended from a hovering helicopter. The samples were iced and brought back to the laboratory for filtering and processing. The other ten stations were in the perimeter canal of WCA 1. Water samples and field readings in the perimeter canal were taken from a boat. The perimeter canal's field readings were recorded using a Hydrolab(R). Interior pH and temperature measurements were made utilizing Colorplast(TM) indicator strips and a laboratory thermometer.

The 68 stations within the Water Conservation Areas are as follows:

Water Conservation Area 1	-	26 stations	(Figure 3)
Water Conservation Area 2A	-	21 stations	(Figure 4)
Water Conservation Area 3A	-	21 stations	(Figure 5)
		68 stations	

Sampling dates for interior water quality stations are also listed in Table 2.

FIGURE 3. WATER CONSERVATION AREA 1 INTERIOR WATER QUALITY STATIONS

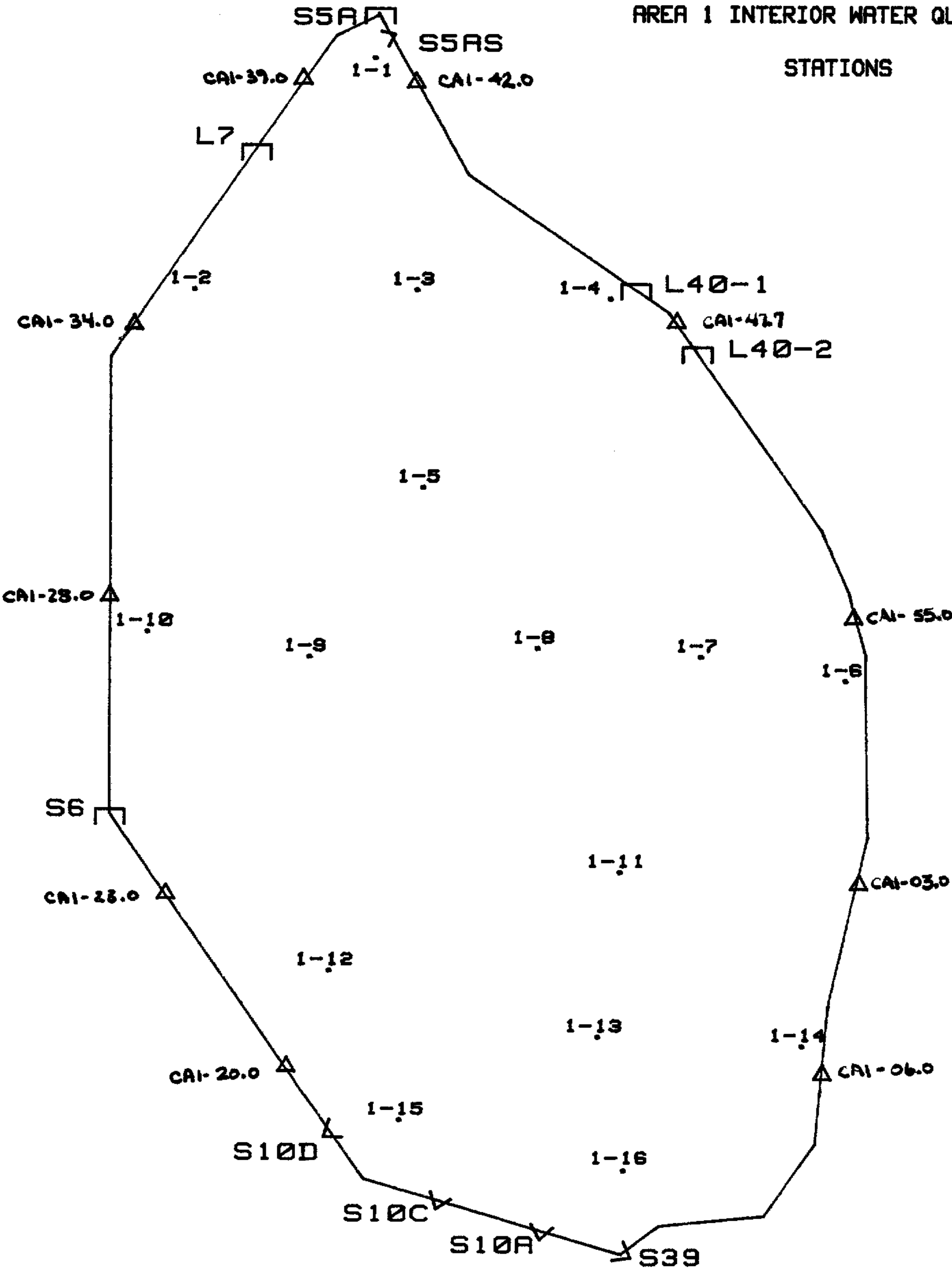


FIGURE 4. WATER CONSERVATION

AREA 2A WATER QUALITY

STATIONS

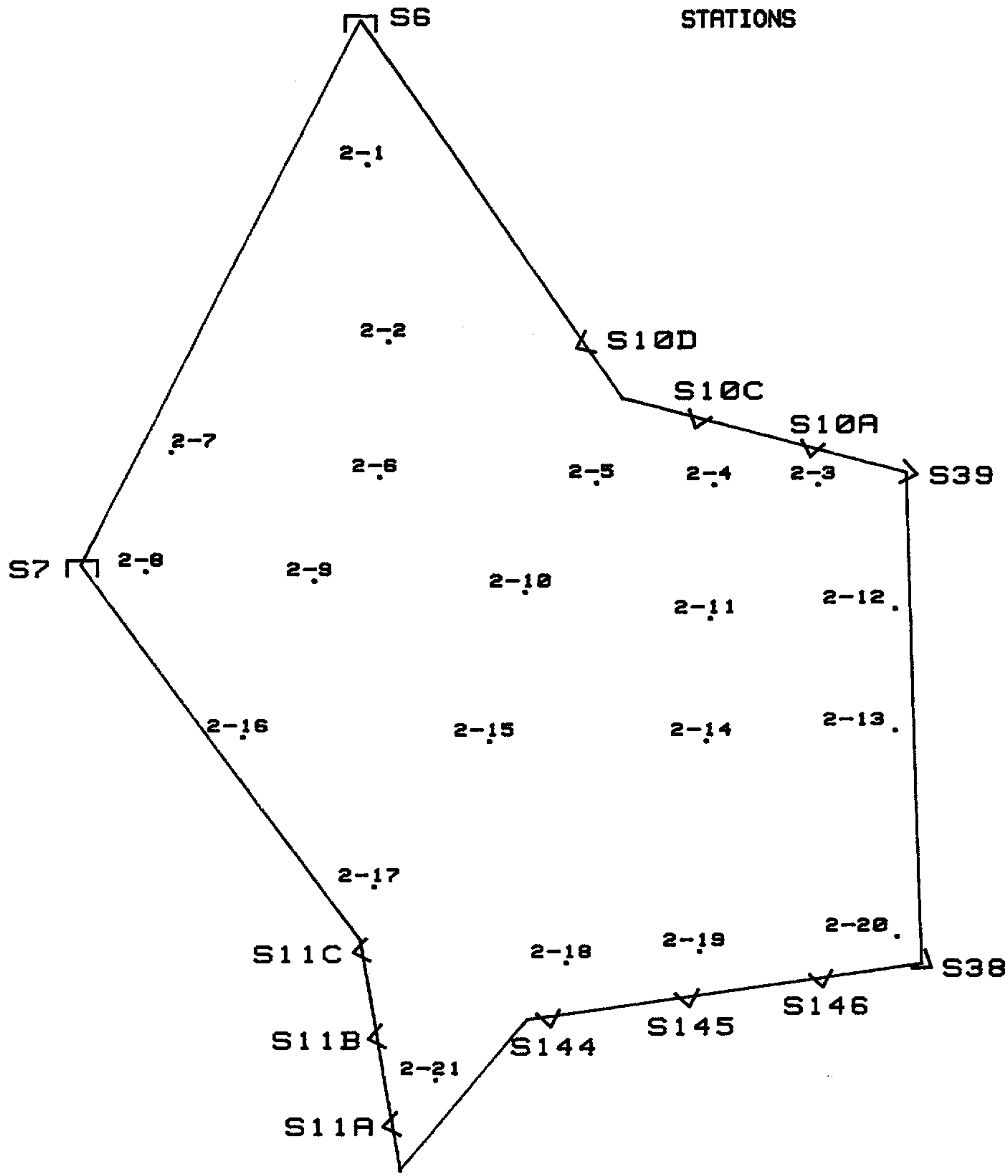
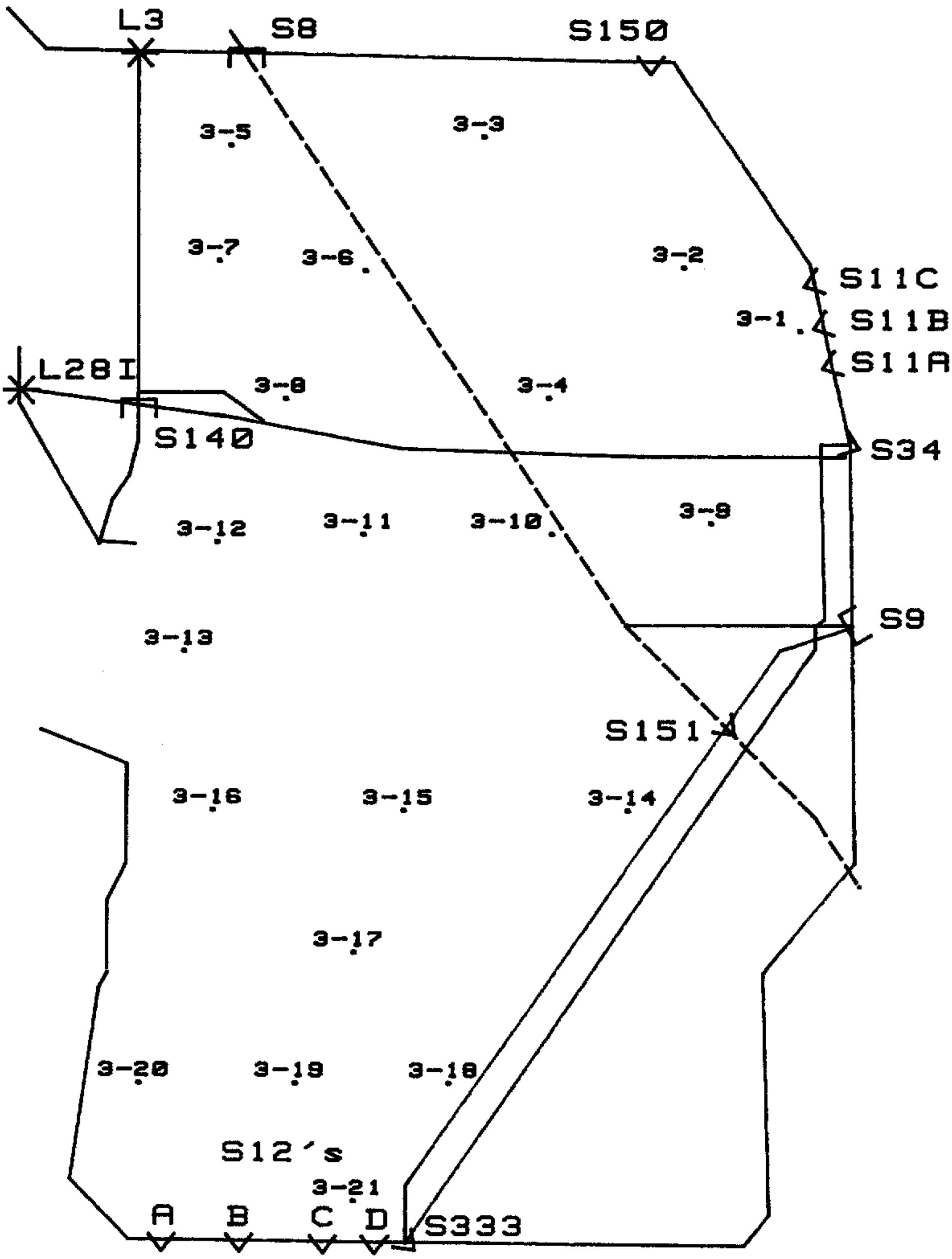


FIGURE 5. WATER CONSERVATION AREA 3A WATER QUALITY STATIONS



Parameters - After collection, water samples were filtered (if applicable) through a 0.45 Nucleopore(R), chilled at 4°C, and later analyzed in the SFWMD laboratory for the following parameters:

Nutrients		Major Ions	Miscellaneous
TPO_4	TKN	*Ca	Turbidity
*OPO_4	*TdKN	*Mg	*Color
*$TdPO_4$	*NO_x	*Na	Total organic carbon
*SiO_2	*NO_2	*K	*Alkalinity
*NH_4		*Cl	*Hardness
		*SO_4	

*Filtered samples → dissolved forms

In addition, analyses of the following dissolved trace metals were performed semi-annually: Cd, Co, Cr, Cu, Mn, Pb, Sr, Zn. All analytical methodologies are listed in Appendix A.

RESULTS AND DISCUSSION

This report deals exclusively with the results of the water samples taken from January 1, 1978 to December 31, 1980. Although most available physical and chemical parameters were analyzed regularly, this interim report will concentrate on the two major nutrient parameters - total nitrogen and total phosphorus, and on the conservative element - chloride.

A more extensive analysis of the data will be presented in a final report to be completed in September 1981. The final report will include all three years of study (1978-1980) with a more comprehensive interpretation of all data collected.

Water Quality of Inflow/Outflow Structures

The water quality of each of the Water Conservation Areas is largely a function of the land use of the drainage basins which flow into the area. Surface inflows into the Water Conservation Areas represent cattle ranching, truck farming, sugar production, and urbanization. Table 6 presents a general breakdown of the land use and land cover inventories of the four major inflow structures (S5A, S6, S7, and S8) which convey water from the Everglades Agricultural Area into the Water Conservation Areas. For a more detailed breakdown of these land use analyses, refer to Appendix B. The nutrient levels at these inflow points are relatively high due to both the highly organic nature of the soils and the buildup of years of fertilizer use (Waller and Earle, 1975). The high nitrogen levels found in the EAA soils are due to the mineralization and nitrification of the muck soils; therefore, the fertilizers used in this area are predominantly phosphorus based. Shannon (1978) noted that soils

TABLE 6. GENERAL BREAKDOWN OF 1979 LAND USE FOR EAA PUMP STATIONS: S5A, S6, S7, and S8

Classification		S5A		S6		S7		S8	
(U)	Urban	1,539	(1%)	60	(<1%)	48	(<1%)	0	(0%)
(A)	Agricultural	114,877	(88%)	81,461	(93%)	63,985	(78%)	23,575	(25%)
(R)	Rangeland	4,536	(3%)	112	(<1%)	0	(0%)	0	(0%)
(W)	Wetlands	8,954	(7%)	5,638	(6%)	16,130	(20%)	68,953	(74%)
(H)	Water	353	(<1%)	316	(<1%)	310	(<1%)	195	(<1%)
(B)	Barren Land	200	(<1%)	0	(0%)	0	(0%)	0	(0%)
(F)	Forested Uplands	0	(0%)	0	(0%)	2,001	(2%)	0	(0%)
	Total	130,459		87,587		82,464		92,723	

Extracted from Division of Land Use, South Florida Water Management District, 1979 such as these, with a long history of phosphorus application, demonstrated a lower capacity for fixation of applied phosphorus and thus drainage waters have relatively elevated phosphorus concentrations.

Table 7 provides a comparative ranking of all 31 stations for the three major parameters: nitrogen, phosphorus, and chloride. The total nitrogen, total phosphorus, and chloride values were highest for those structures which discharge agricultural drainage. For all Water Conservation Area structures monitored the total nitrogen two year means ranged from a low of 1.44 mg/L for the L28 Interceptor Canal (natural) to a high of 5.32 mg/L for S5A (agricultural). Similarly the mean total phosphorus values ranged from a low of 0.008 mg/L for the S145 (WCA 2A to WCA 2B) culvert to a high of 0.123 mg/L at S5AS (WCA 1 outflow). The range of chloride values was extensive. The two year mean values varied from a low of 29.1 mg/L for the S12A (WCA 3 outflow) structure to a high of 368.3 mg/L for the L7 (agricultural) pump station.

Figures 6 through 14 represent the temporal variations in nitrogen, phosphorus, and chloride values with an overlying hydrograph of discharge rates for three major inflow structures. The graph of S5A water quality is representative of an agricultural inflow. The graphs for L28I and S9 represent natural and urban watersheds, respectively. The graphs for S5A display the highest nitrogen, phosphorus, and chloride values. Both the average values and the peaks reflect these nutrient-rich agricultural waters. The hydrograph for S5A also indicates relatively heavy discharge activity. There is evidence of a rise in nutrient concentration shortly after initiation of a pumping sequence which would indicate that pumping activity draws nutrient enriched waters out of the S5A drainage area.

TABLE 7. COMPARATIVE RANKING OF WATER CONSERVATION AREA INFLOW/OUTFLOW STATIONS

Concentration	Total Nitrogen	Total Phosphorus	Chlorides
Highest	S5A (5.32)	S5AS (0.123)	L7 (368.3)
	S5AS (5.20)	S5A (0.120)	S5AS (240.9)
	L7 (4.41)	S10D (0.093)	S5A (212.1)
	S6 (4.19)	L7 (0.090)	S6 (203.3)
	L40-2 (4.09)	L3 (0.083)	S10D (194.0)
	S10D (4.00)	L40-2 (0.080)	L40-1 (186.7)
	L40-1 (3.56)	S6 (0.078)	S7 (164.7)
	S39 (3.46)	S140 (0.068)	S10C (153.8)
	S10C (3.40)	S7 (0.053)	S150 (153.7)
	S8 (3.31)	S39 (0.053)	S11B (152.0)
	S7 (3.27)	L40-1 (0.053)	L40-2 (151.7)
	S10A (3.13)	S10C (0.052)	S39 (150.5)
	S150 (3.09)	S150 (0.051)	S144 (149.2)
	S11C (2.58)	S11A (0.050)	S10A (148.0)
	S11A (2.52)	S8 (0.046)	S145 (146.2)
	S11B (2.49)	L28I (0.041)	S146 (143.3)
	S34 (2.40)	S10A (0.040)	S11C (142.1)
	S146 (2.37)	S11C (0.025)	S38 (142.0)
	S38 (2.29)	S151 (0.020)	S34 (141.0)
	S144 (2.27)	S11B (0.020)	S11A (139.7)
	S145 (2.22)	S333 (0.015)	S151 (112.8)
	S151 (2.18)	S9 (0.012)	S9 (108.3)
	S9 (2.13)	S12D (0.012)	S8 (93.5)
	S333 (2.07)	S34 (0.011)	S333 (91.9)
	S12D (1.98)	S12C (0.011)	S12D (88.9)
	L3 (1.96)	S144 (0.010)	S12C (67.6)
	S140 (1.91)	S12B (0.010)	L28I (49.9)
	S12C (1.88)	S146 (0.009)	S140 (41.5)
	S12B (1.60)	S12A (0.009)	L3 (41.2)
	S12A (1.55)	S38 (0.008)	S12B (39.9)
Lowest	L28I (1.44)	S145 (0.008)	S12A (29.1)

* all values represent 1978-79 mean values in mg/l

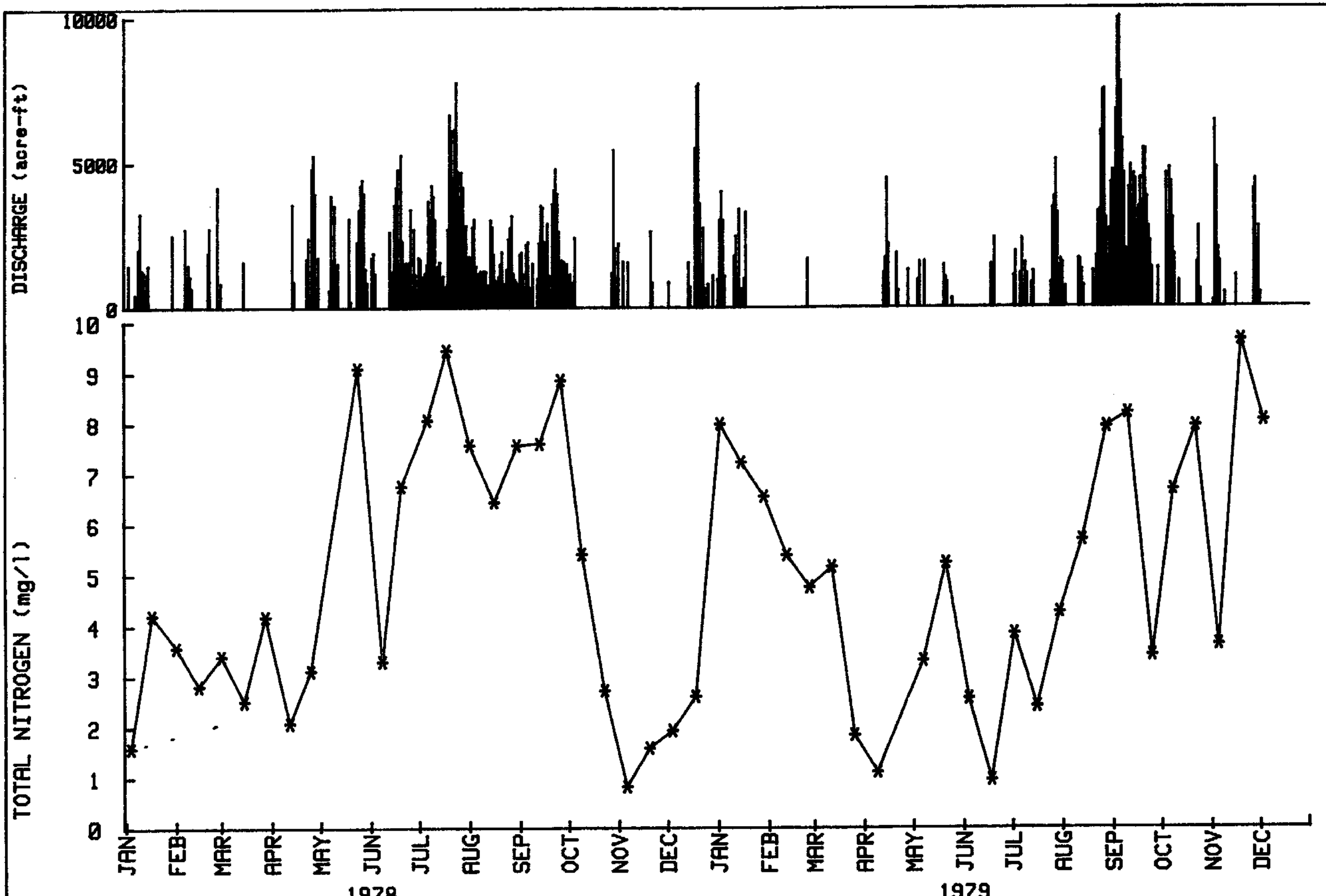


FIGURE 6. TOTAL NITROGEN AND DISCHARGE DATA FOR S5A : 1978-79

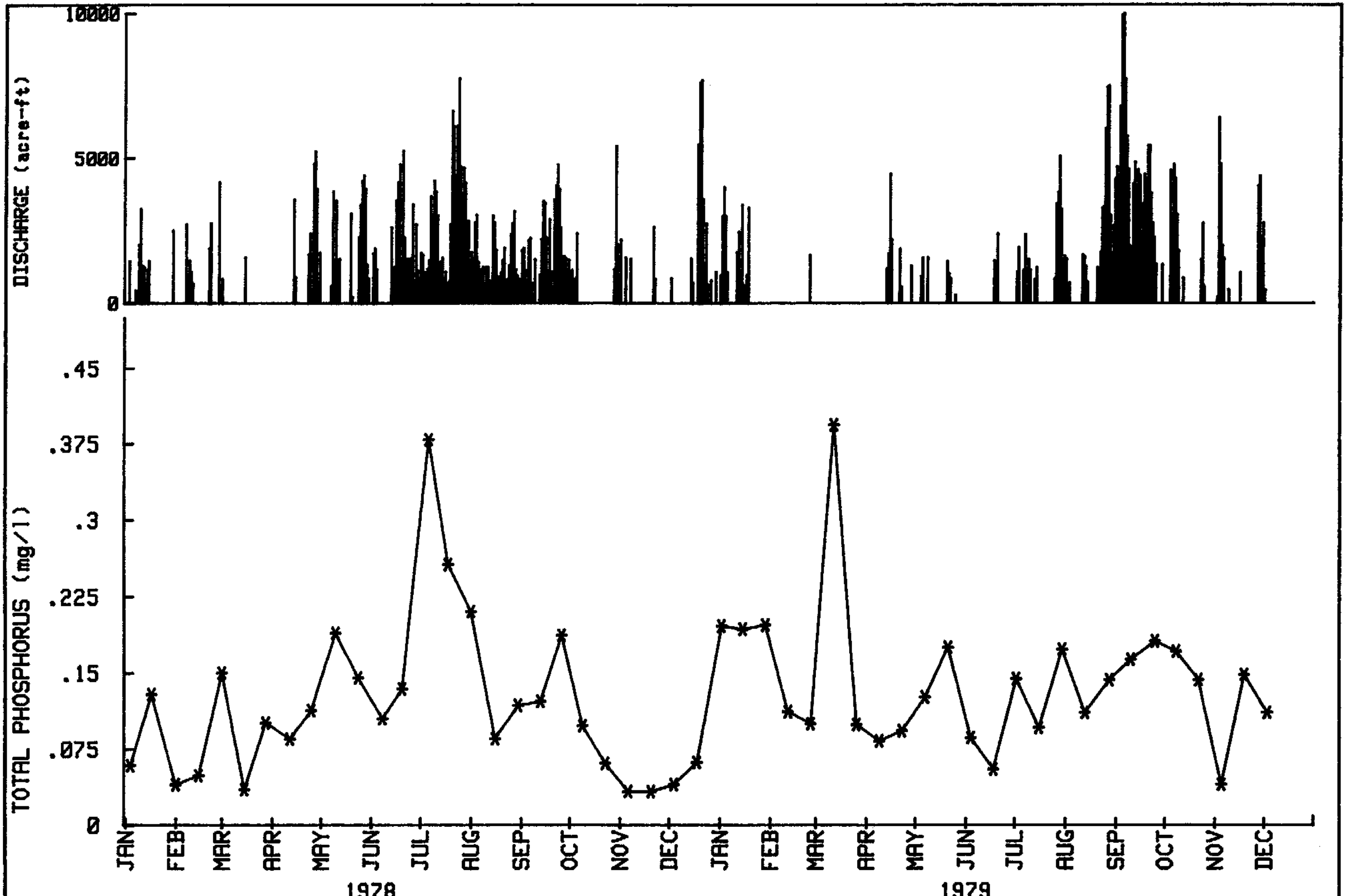


FIGURE 7. TOTAL PHOSPHORUS AND DISCHARGE DATA FOR S5A : 1978-79

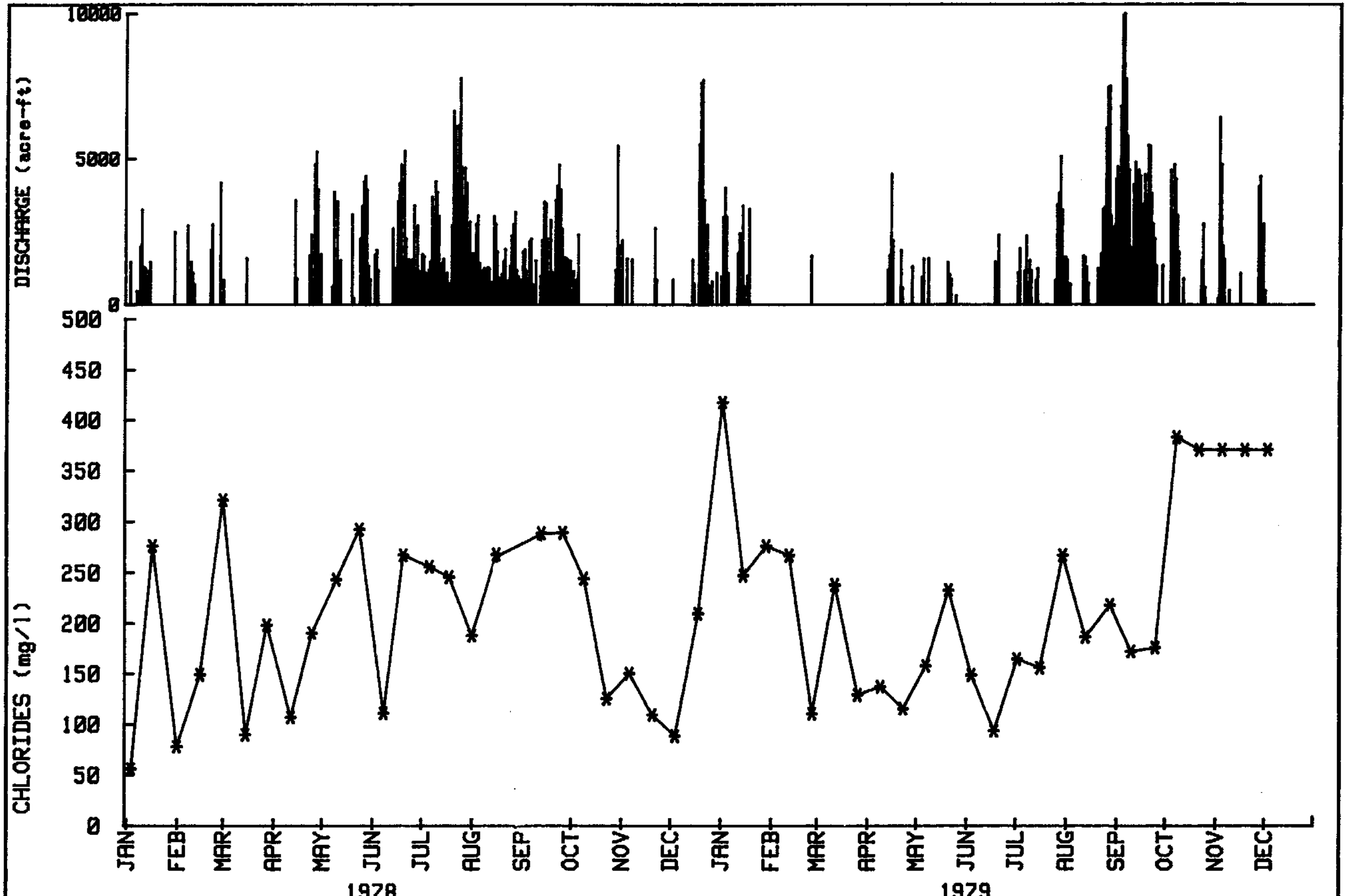


FIGURE 3. CHLORIDE AND DISCHARGE DATA FOR S5A : 1978-79

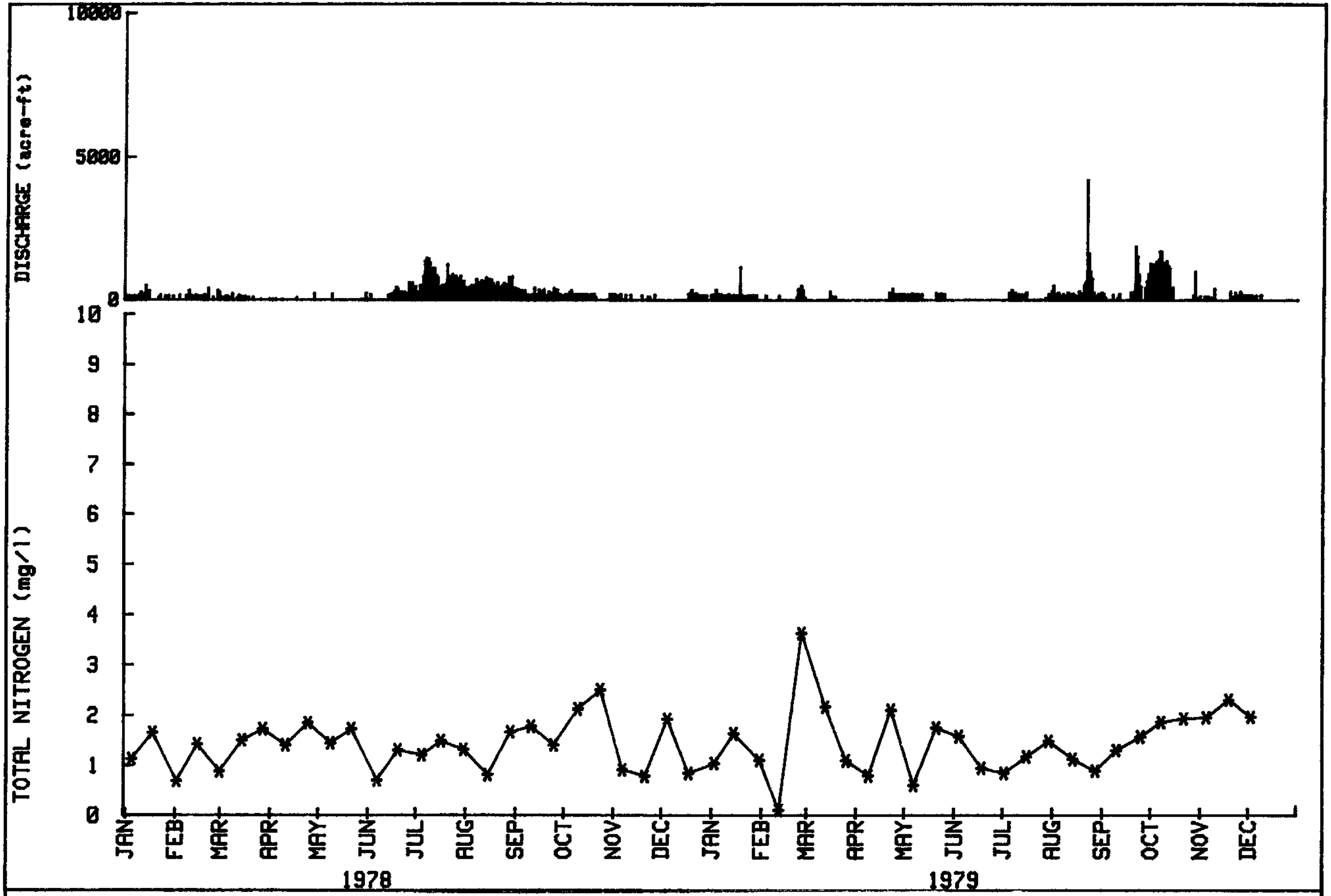


FIGURE 9. TOTAL NITROGEN AND DISCHARGE DATA FOR L28I : 1978-79

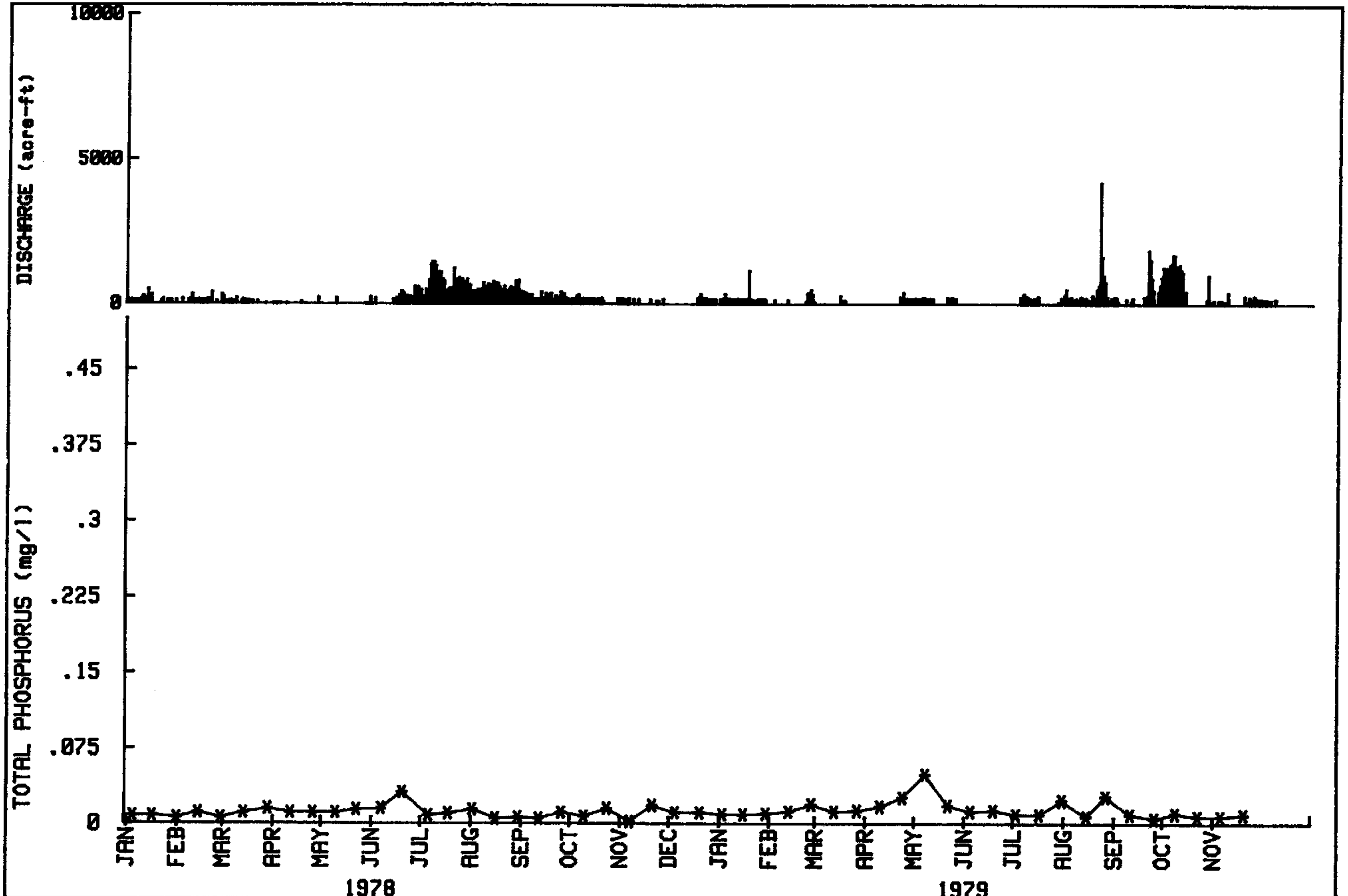


FIGURE 10. TOTAL PHOSPHORUS AND DISCHARGE DATA FOR L28I : 1978-79

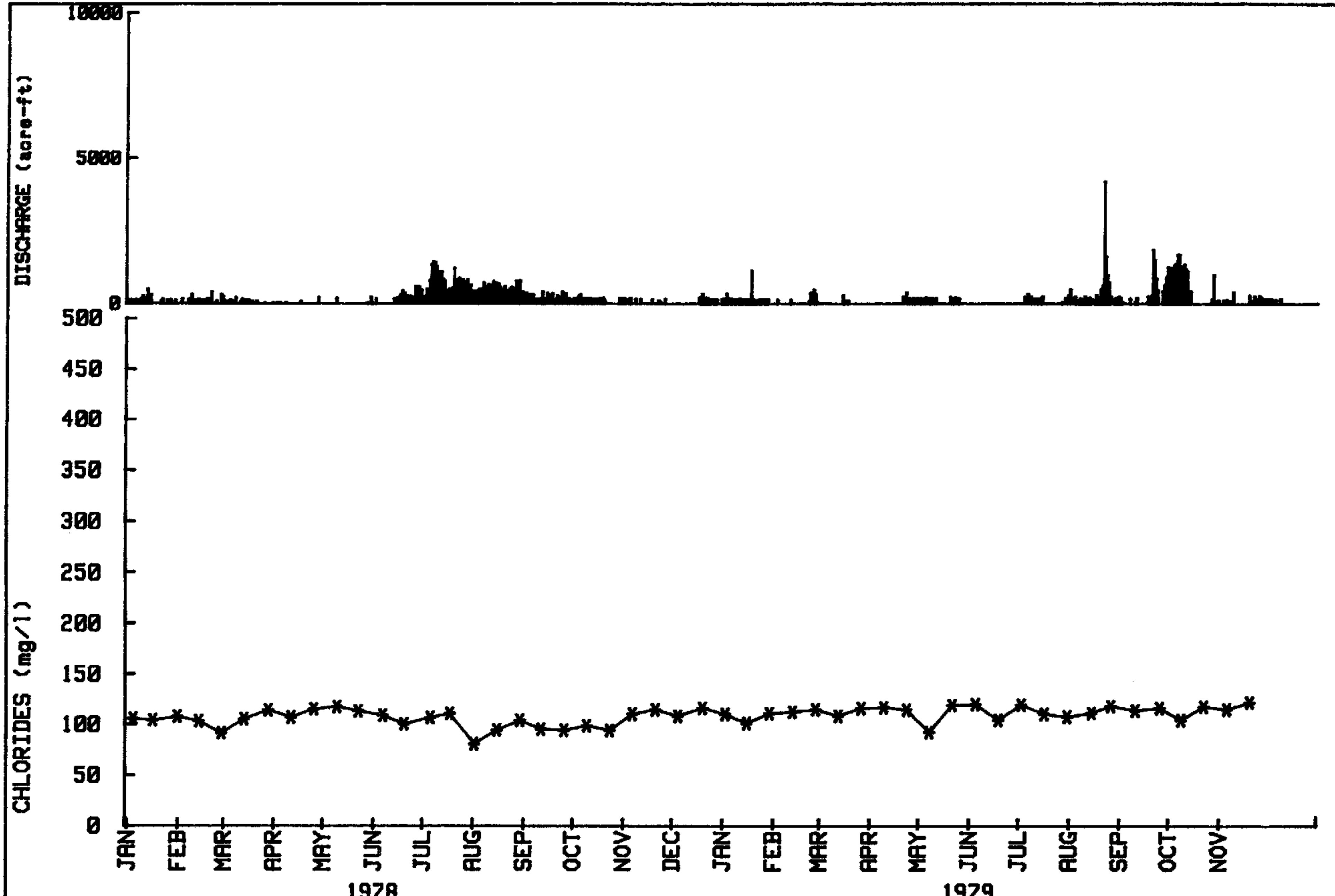


FIGURE 11. CHLORIDE AND DISCHARGE DATA FOR L28I : 1978-79

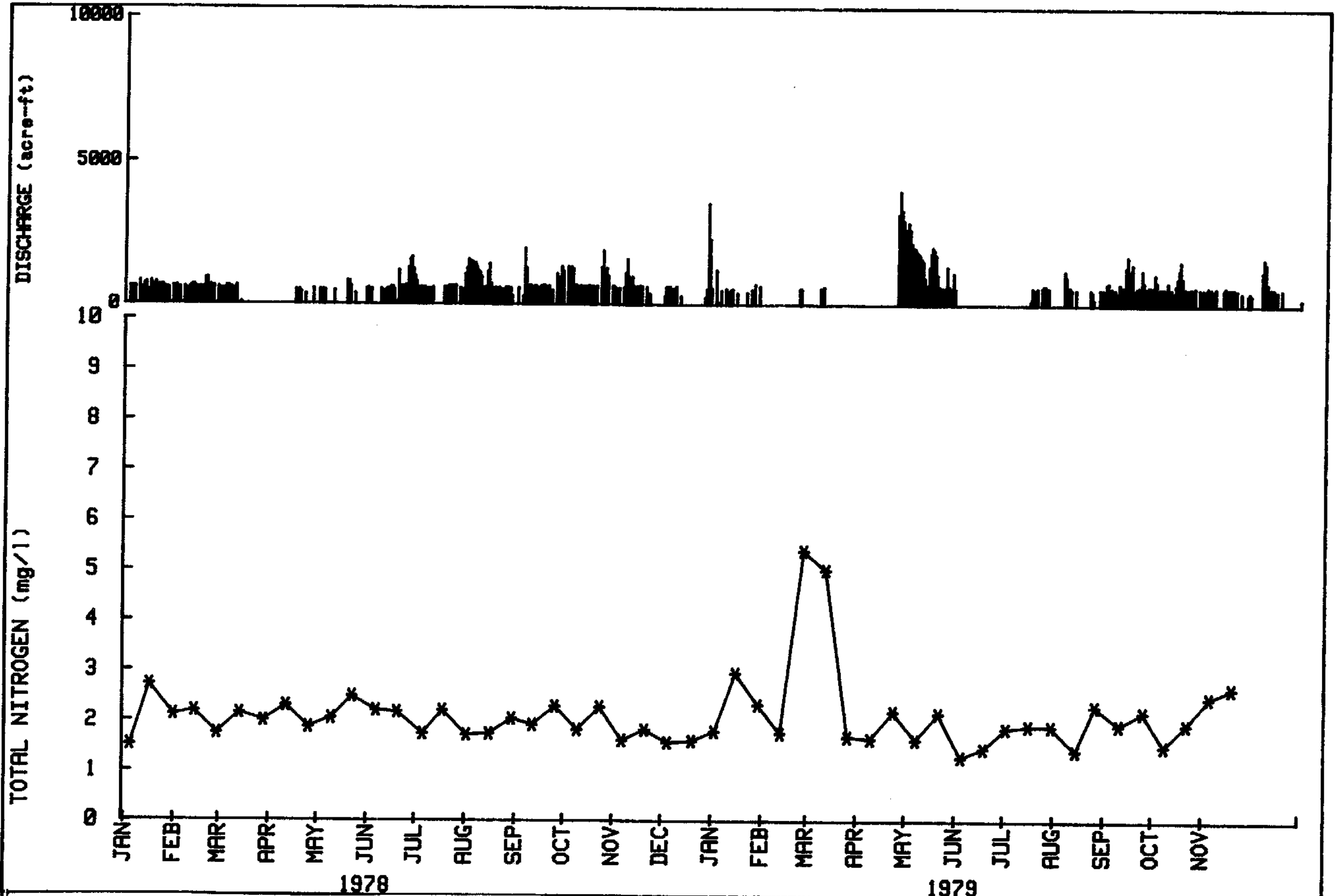


FIGURE 12. TOTAL NITROGEN AND DISCHARGE DATA FOR S9 : 1978-79

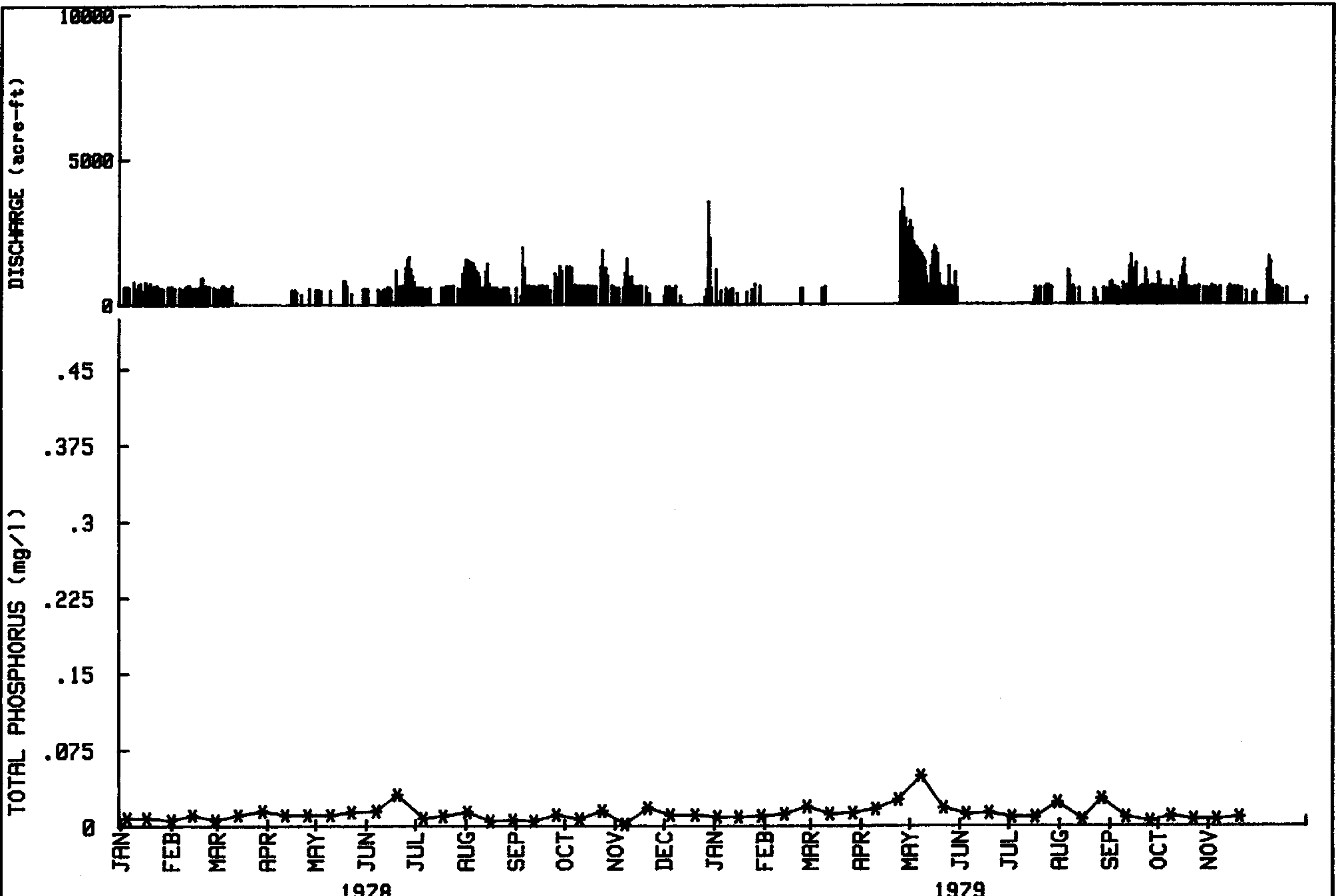


FIGURE 13. TOTAL PHOSPHORUS AND DISCHARGE DATA FOR S9 : 1978-79

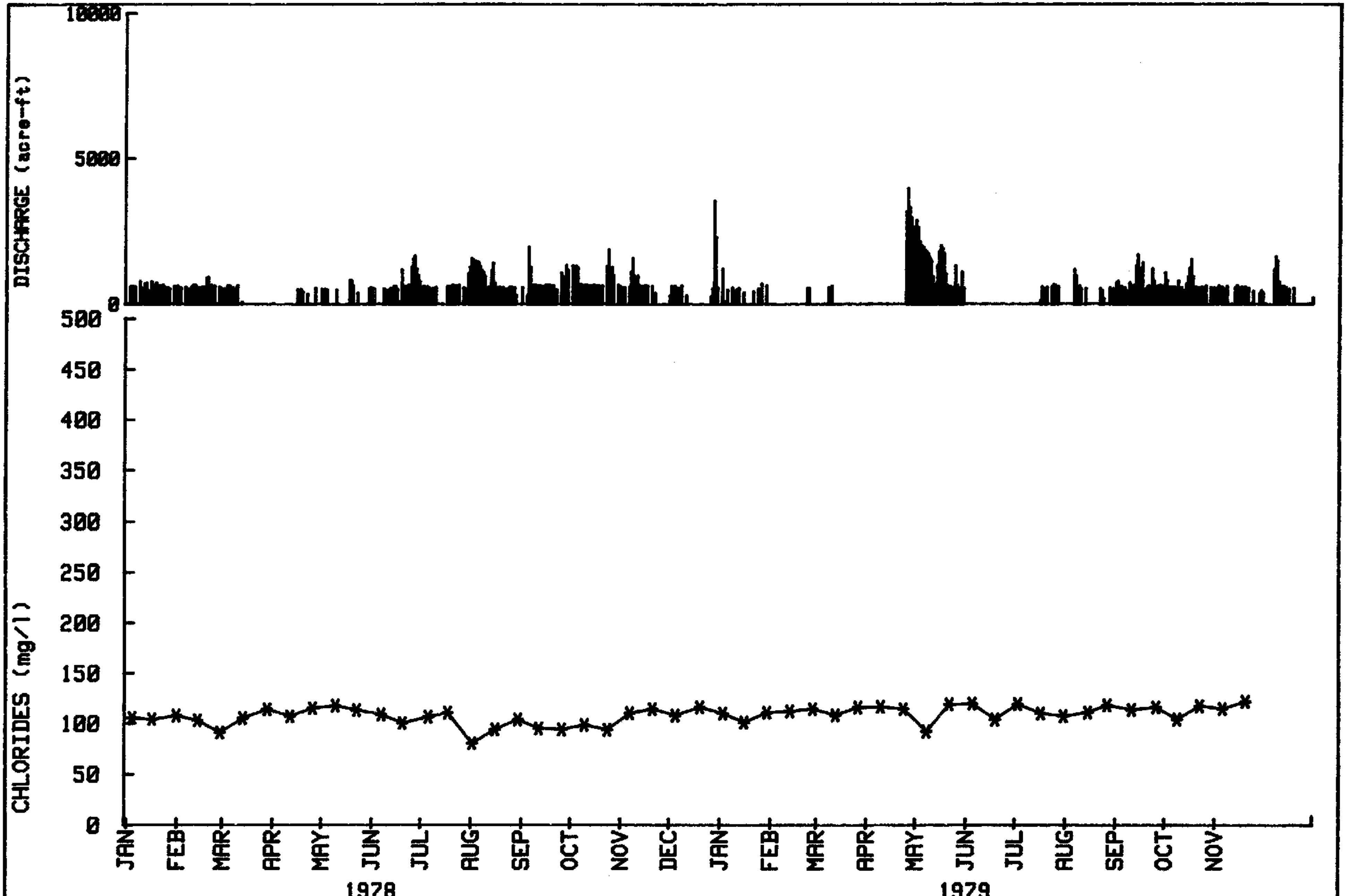


FIGURE 14. CHLORIDE AND DISCHARGE DATA FOR S9 : 1978-79

The S9 nitrogen, phosphorus, and chloride graphs which represent urban runoff are more moderate. The corresponding graphs for L28I indicate relatively low nutrient concentrations. There does not seem to be any direct correlation at L28I between discharge activity and resultant water quality.

Loading Data

Since one of the primary purposes of the program is to provide a detailed nutrient budget analysis for the Water Conservation Areas, measurements of water quality entering the area need to be correlated with the quantity of water being discharged. Using a loading program (Chem 11, Appendix C), flow or discharge rates as compiled by the Jacksonville Office of the Army Corps of Engineers (COE) are combined with the respective water chemistry values to provide a flow proportional estimate of the contribution of each of the inflow points to the overall water quality of the receiving waters. Since it was infeasible to collect water quality data on a daily basis, two chronologically successive chemistry data points were averaged and correlated with the associated flow data to provide daily loading values (Schneider, et al, 1979). Successive daily loadings were totaled to provide an annual calculation of nutrient loads. Nutrient loads for NO_x, NO_2, NO_3, NH_4, Organic N, total N, O-PO_4, TPO_4, and Cl are presently calculated for the entire two year period (1978-1979) and are available upon request.

A budget analysis provides a valuable tool for assessing the nutrient dynamics of an aquatic system. The budget analysis will provide quantitative estimates of the import and export nutrient loads as well as a percent retention value for the selected nutrient parameters. Tables 8 through 10 represent 1978-79 two year material budgets for the three Water Conservation Areas.

For Water Conservation Area 1, the two Everglades Agricultural Area (EAA) structures (S5A and S6) contribute 67% of the phosphorus and 85% of the total nitrogen even though they contribute only 42% of the water. Of the four gates which drain WCA 1, three of these (S10A, S10C, and S10D), which convey water from WCA 1 to WCA 2A, account for 94% of the exported phosphorus and 92% of the exported nitrogen from WCA 1.

The three S10 structures (S10A, S10C and S10D) convey water from WCA 1 to WCA 2A. Geographically S10D is the closest of the three structures to the S6 pump station. As a result the water passing through the S10D structure more closely reflects that of S6 agricultural drainage. During periods of S6 discharge the extent of impact these nutrient enriched waters have on the WCA 1 interior is minimal. Instead, the discharge flows down the WCA 1 perimeter canal, through the S10D structure, and out into the WCA 2A marsh. The nutrient concentrations, discharge quantities, and related nutrient loads decrease from S10D to S10C to S10A, respectively. In all, the three S10 structures contribute 75% of the phosphorus, 71% of the nitrogen, and 71% of all surface (does not include rainfall) inflows to WCA 2A.

The S11A, S11B, and S11C structures are the primary outflows from WCA 2A. These three structures, which account for the majority of the surface water and associated nutrient exports for WCA 2A, convey water to WCA 3A. This proportion is small, however, when compared to the hydrologic contribution by rainfall (56%).

TABLE 8. 1978-1979 WATER CONSERVATION AREA 1
BUDGET ANALYSIS (78-79 Combined Loadings)

Source	Total Phosphorus	Total Nitrogen	Chloride	Flow (A-F)
Inflows to Water Conservation Area 1				
S5A	101.80 (50%)	5743.58 (63%)	180,546 (66%)	591,924 (32%)
S6	35.42 (17%)	2039.66 (22%)	85,896 (32%)	188,924 (10%)
Rainfall	67.44 (33%)	1370.40 (15%)	5,572 (2%)	1,072,134 (58%)
Total	204.66	9153.64	272,014	1,852,982
Outflows from Water Conservation Area 1				
S39	4.68 (6%)	344.84 (8%)	17,366 (9%)	94,254 (5%)
S10A	4.62 (6%)	445.10 (10%)	25,894 (13%)	146,896 (7%)
S10C	21.00 (26%)	1469.64 (33%)	57,380 (29%)	294,096 (14%)
S10D	49.96 (62%)	2211.72 (49%)	98,174 (49%)	408,860 (20%)
Evaporation	-	-	-	1,124,424 (54%)
Total	80.26	4471.30	198,814	2,068,530
Total Input	204.66	9153.64	272,014	1,852,982
Total Output	80.26	4471.30	198,814	2,068,530
Δ Storage	-4.40	-368.10	-19,910	-18,348
Other sinks	128.80	5050.14	93,110	-197,200

Retentions:

Total Phosphorus 63%
Total Nitrogen 55%

TABLE 9. 1978-79 WATER CONSERVATION AREA 2A
BUDGET ANALYSIS (Combined Loadings)

Inflows to Water Conservation Area 2A

Source	Total Phosphorus		Total Nitrogen		Chloride		Flow (A-F)	
S-7	25.08	(16%)	1669.70	(24%)	69,778	(27%)	351,066	(17%)
S10A	4.62	(3%)	445.10	(6%)	25,894	(10%)	146,896	(7%)
S10C	21.00	(13%)	1469.64	(21%)	57,380	(23%)	294,096	(14%)
S10D	49.96	(32%)	2211.72	(32%)	98,174	(38%)	408,860	(19%)
Rainfall	56.98	(36%)	1169.24	(17%)	4,762	(2%)	910,306	(43%)
Total	157.64		6965.40		255,988		2,111,224	

Outflows from Water Conservation Area 2A

S38	0.26	(2%)	119.52	(4%)	8,462	(4%)	42,230	(2%)
S144	0.52	(3%)	148.78	(5%)	12,410	(7%)	64,118	(3%)
S145	0.50	(3%)	171.58	(6%)	12,594	(7%)	66,224	(4%)
S146	0.66	(4%)	153.86	(5%)	10,278	(5%)	55,782	(3%)
S11A	3.56	(21%)	605.50	(21%)	42,206	(22%)	237,192	(13%)
S11B	4.42	(26%)	789.64	(27%)	53,746	(28%)	253,234	(13%)
S11C	6.82	(41%)	944.78	(32%)	51,470	(27%)	282,498	(15%)
Evaporation	-						880,206	(47%)
Total	16.54		2933.66		191,166		1,881,484	
Total input	157.64		6965.40		255,988		2,111,224	
Total output	16.54		2933.66		191,166		1,881,484	
Δ storage	5.37		151.77		29,025		81,000	
Other sinks	135.73		3879.97		35,797		148,740	

Retentions:

Total phosphorus 86%

Total nitrogen 56%

TABLE 10. 1978-79 WATER CONSERVATION AREA 3A BUDGET ANALYSIS
(Combined Two Year Loading)

Inflows to Water Conservation Area 3A

Source	Total Phosphorus		Total Nitrogen		Chloride		Flow (A-F)	
S8	53.50	(14%)	3108.96	(25%)	71,218	(22%)	606,814	(11%)
S9	6.12	(1%)	723.82	(6%)	37,944	(12%)	292,546	(5%)
S140	37.48	(10%)	626.96	(5%)	9,904	(3%)	267,188	(5%)
S150	11.22	(3%)	671.82	(5%)	28,538	(9%)	145,654	(3%)
L28I	11.32	(3%)	221.54	(2%)	6,052	(2%)	123,102	(2%)
L3	44.22	(12%)	682.20	(5%)	8,508	(3%)	247,376	(4%)
S11A	3.56	(1%)	605.50	(5%)	42,206	(13%)	237,192	(4%)
S11B	4.42	(1%)	789.64	(6%)	53,746	(16%)	253,234	(5%)
S11C	6.82	(2%)	944.78	(8%)	51,470	(15%)	282,518	(5%)
Rainfall	198.32	(53%)	4040.92	(33%)	16,428	(5%)	3,160,998	(56%)
Total	376.98		12416.14		326,034		5,616,602	

Outflows from Water Conservation Area 3A

Source	Total Phosphorus		Total Nitrogen		Chloride		Flow (A-F)	
S151	5.06	(34%)	588.96	(22%)	27,934	(25%)	204,962	(4%)
S12A	0.58	(4%)	111.72	(4%)	1,054	(1%)	67,260	(1%)
S12B	0.48	(3%)	141.54	(5%)	2,908	(3%)	82,862	(2%)
S12C	3.80	(25%)	909.74	(33%)	37,304	(33%)	406,296	(8%)
S12D	5.06	(34%)	997.34	(36%)	42,708	(38%)	395,316	(8%)
Evaporation	-		-		-		3,999,108	(77%)
Total	14.98		2747.30		111,909		5,155,804	
Total input	376.98		12416.14		326,034		5,616,602	
Total output	14.98		2747.30		111,909		5,155,804	
Δ storage	19.14		735.15		8,707		263,583	
Other sinks	342.86		8933.69		205,418		197,215	

Retentions:

Total Phosphorus 91%

Total Nitrogen 72%

The S8 structure also drains the EAA and pumps directly into WCA 3A. It represents the largest surface inflow into the area contributing 17% of the water, 16% of the phosphorus, and 24% of the nitrogen.

Rainfall is a sizable contributor of phosphorus to all three Water Conservation Areas: 33%, 36%, 53% for WCA 1, WCA 2A, and WCA 3A, respectively. The percent contribution by rainfall for total nitrogen, however, drops to less than 20% for both WCA 1 and WCA 2A and 33% for WCA 3A. Since the chloride concentration in rainfall is low, the percent of the inflow budget attributed to rainfall is small, 2%, 2%, and 5% for WCA 1, 2A, and 3A, respectively.

In general, the phosphorus, nitrogen, and chloride loadings were very similar in WCA 1 and WCA 2A as were rainfall and discharge estimates for the two areas. Water Conservation Area 3A's total nutrient loads were approximately twice those of Area 1 or 2A due primarily to the greater nutrient loads attributed by rainfall over the much larger surface area of WCA 3A.

Figures 15 through 17 graphically represent these material budgets as a percent contribution of each of the inflows to the total per annum nutrient loadings for each of the three areas. Quantitative rainfall values used in the assessment of the nutrient budgets are largely extracted from monthly budget sheets provided by the U.S. Army Corps of Engineers (Table 11). Qualitative rainfall estimates of nitrogen, phosphorus, and chlorides are extracted from District rainfall collectors located in south Florida.

FIGURE 15. TOTAL PHOSPHORUS LOADS FOR WCA INFLOWS

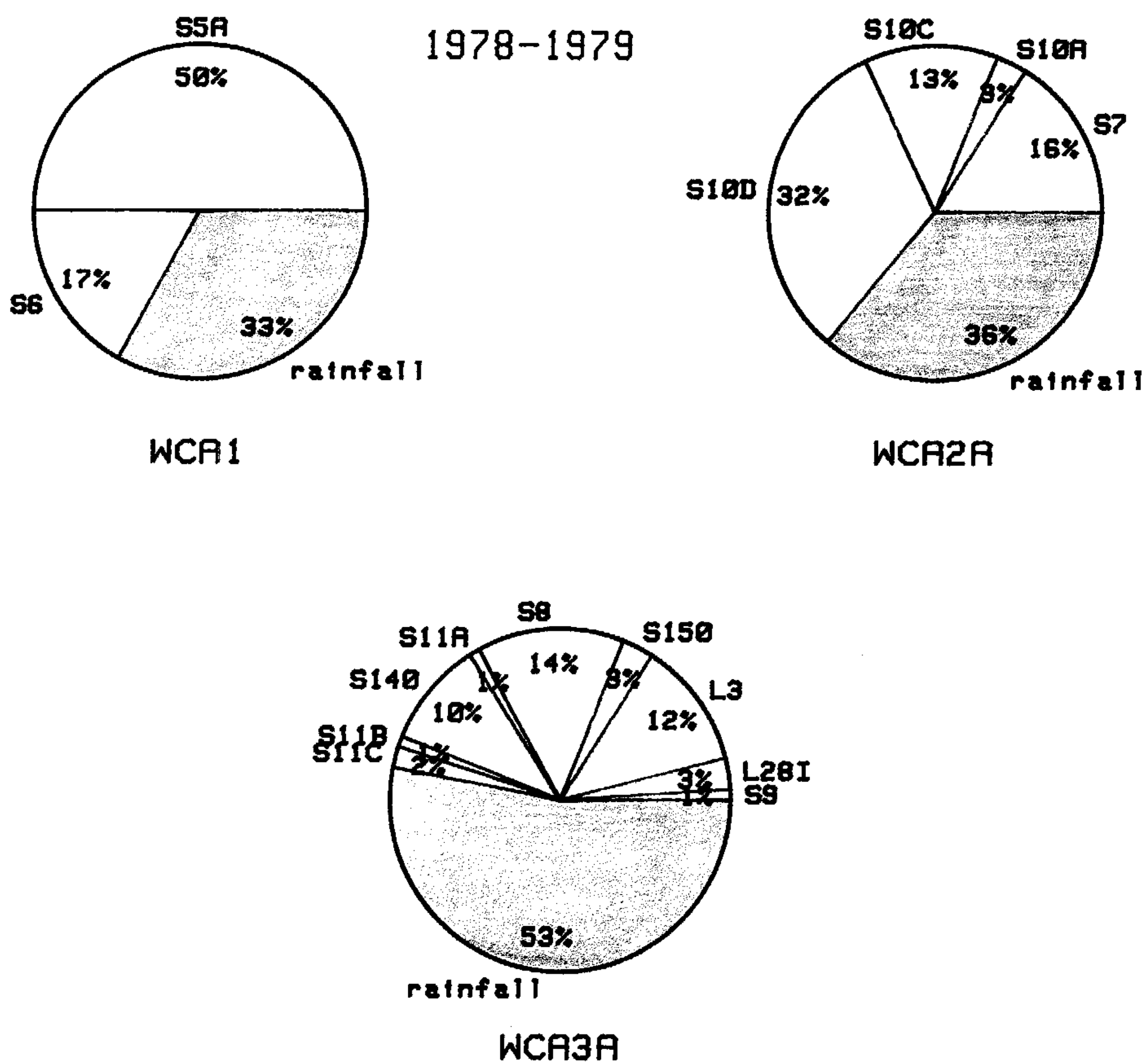


FIGURE 16. TOTAL NITROGEN LOADS FOR WCA INFLOWS

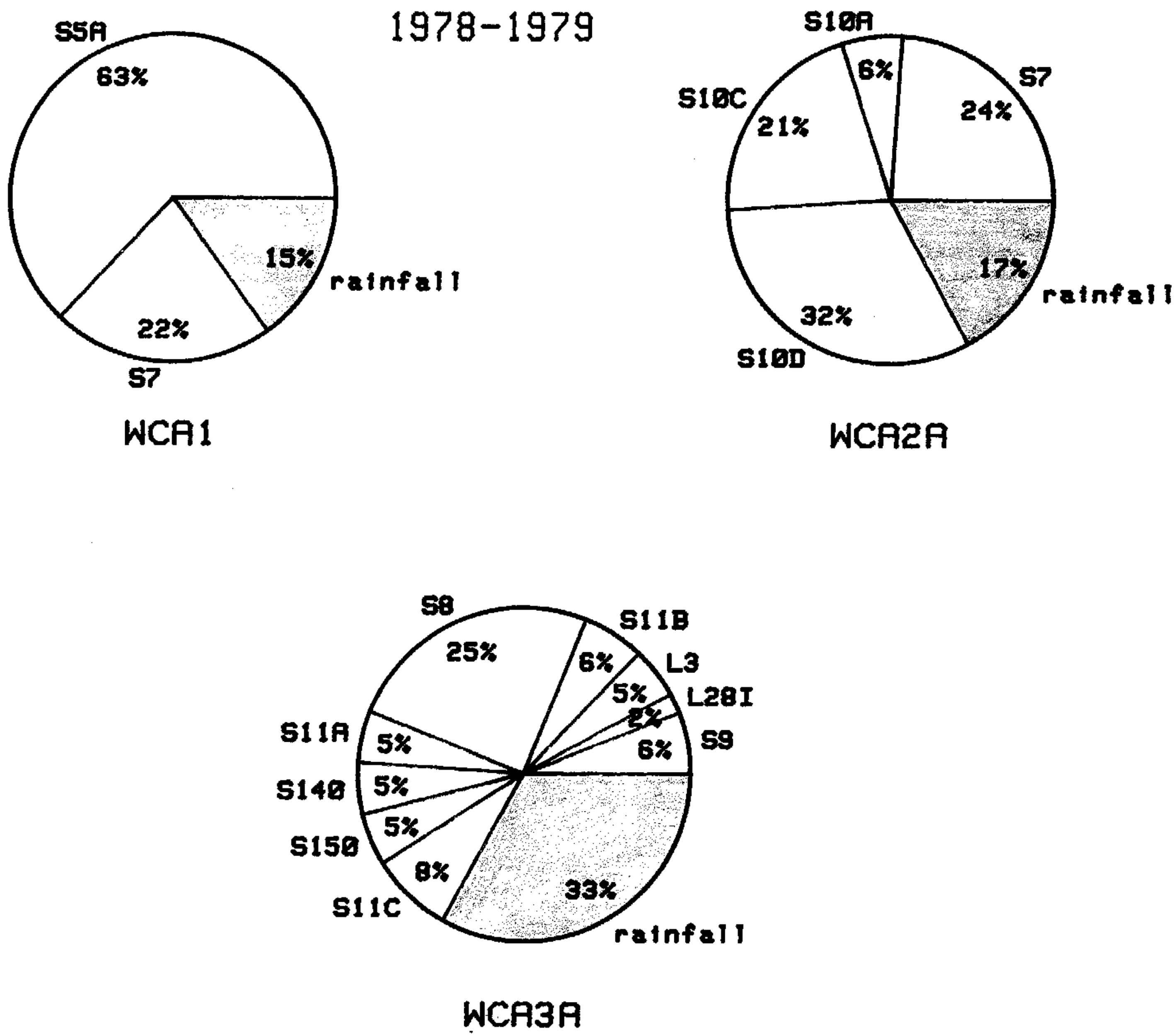


FIGURE 17. CHLORIDE LOADS FOR WCA INFLOWS

1978-1979

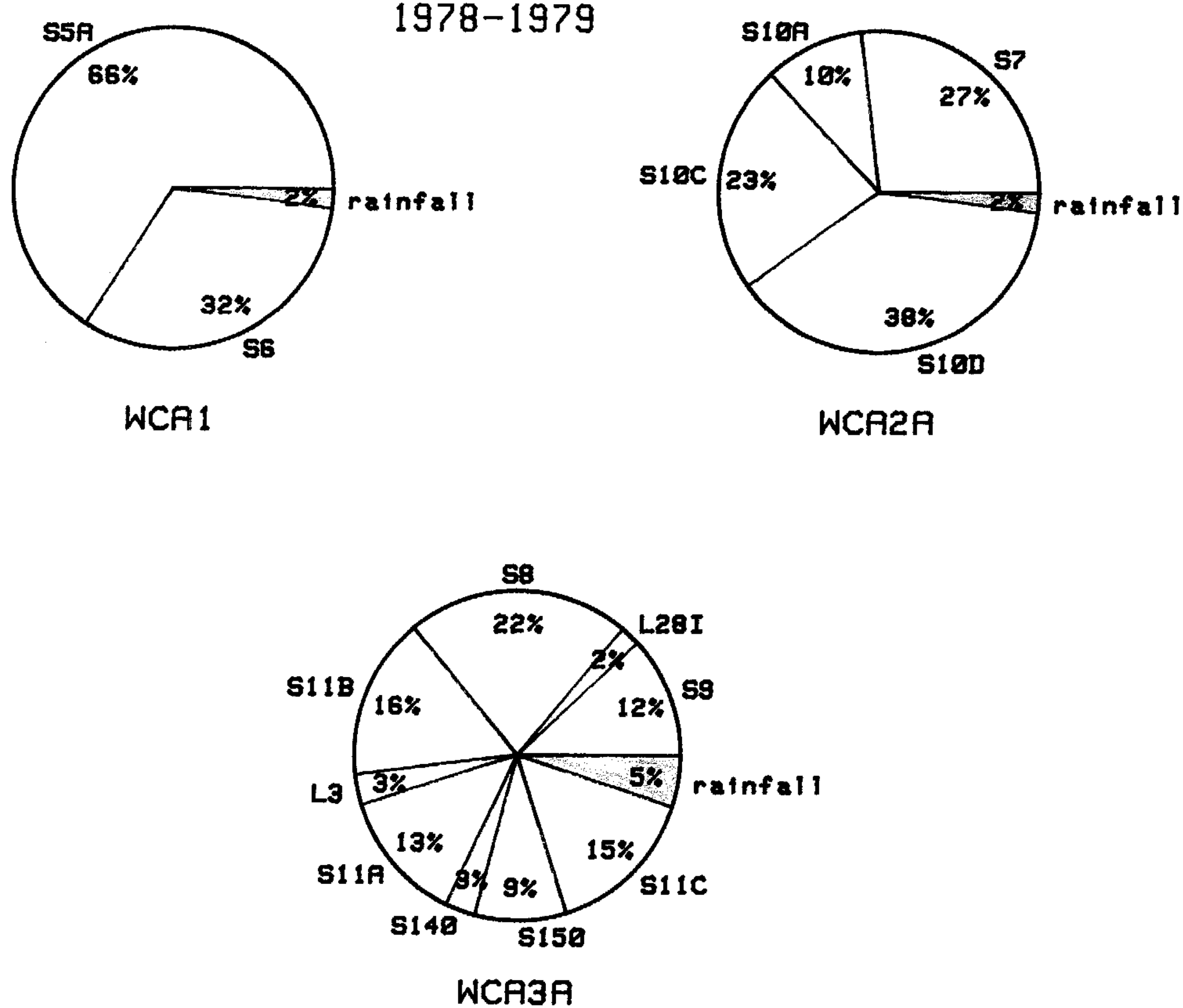


TABLE 11. RAINFALL IN THE WATER CONSERVATION AREAS

	Cons. Area 1		Cons. Area 2A		Cons. Area 3A		Normal for all Cons. Areas
	1978	1979	1978	1979	1978	1979	
January	2.66	2.52	1.23	1.42	2.06	2.58	1.54
February	2.15	0.48	2.04	0.32	2.35	0.46	2.01
March	1.82	1.48	2.53	1.00	2.50	1.04	1.98
April	0.79	3.37	0.71	4.34	0.78	4.66	2.48
May	2.92	3.29	1.50	4.30	2.10	3.73	4.28
June	8.57	3.27	3.91	3.83	5.02	2.76	7.76
July	8.16	4.05	8.79	5.47	9.05	6.69	7.07
August	3.83	5.66	4.79	5.03	5.42	4.86	6.75
September	7.42	11.44	3.54	8.96	4.85	7.89	7.51
October	3.05	3.05	3.94	4.09	3.72	1.85	6.04
November	4.94	3.52	2.16	2.54	1.89	3.07	1.71
December	1.94	2.76	1.17	3.30	1.70	1.22	1.48
Total	48.25	44.89	36.31	44.60	41.44	40.81	50.61

- All readings in inches.
  Data extracted from Conservation Area Water Budgets as compiled by Army Corps office, Jacksonville

Water Quality of Interior Sites

The summary of 1978-1979 chemistry data for each of the stations which make up both the inflow-outflow and interior projects will not be included in this report but is available upon request. Table 12 represents all 26 stations of WCA 1 averaged together for the entire two year period, 1978-1979. Similarly, Tables 13 and 14 provide a two year summary of all interior stations within WCA 2A and WCA 3A, respectively. Table 15 ranks these chemical parameters, by conservation area, from highest to lowest.

Since all three Water Conservation Areas share similar geochemical origins, any differences in water chemistries are probably the result of the combined effect of input quality and local biochemical activity. Water Conservation Area 1 exhibited the highest nutrient concentrations for all species of nitrogen and phosphorus tested within the three areas. In addition, WCA 2A followed second to WCA 1 in all nutrient parameters except particulate nitrogen. Water Conservation Area 3A consistently displayed the lowest nitrogen and phosphorus concentrations. These results are congruous with the quality of inflows as presented in the 1978-79 budget analysis.

The major cations produced a different case. The concentrations for all measured ions were substantially higher in Water Conservation Area 2A than for either of the other two study areas. The data from loading analysis supports this finding. Not only is S7 a high source of major cations but also the S6 discharge waters, delivered via the S10 structures, appear to be heavy contributors to the overall high level of ions in WCA 2A.

TABLE 12. SUMMARY OF WATER CHEMISTRY DATA FOR WATER CONS. AREA 1, 1978-1979

PROJECT CAWQ   DATE OF PRINTING 04/15/81

PARAMETER   RANGE OF VALUES   UNITS

DATE   1/ 1/78 - 12/31/79 MO/DA/YR

STATIONS CA1-1 CA1-2 CA1-3 CA1-4 CA1-5
CA1-6 CA1-7 CA1-8 CA1-9 CA1-10
CA1-11 CA1-12 CA1-13 CA1-14 CA1-15
CA1-16 CA1-03.0 CA1-06.0 CA1-20.0 CA1-23.0
CA1-28.0 CA1-34.0 CAU-39.0 CA1-42.0 CA1-47.7
CA1-55.0

	STATION CODE	DATE MO/DA/YR	DEPTH METERS	TEMP CENT	D.O. MG/L	SP COND UMHOS/CM	LAB COND UMHOS/CM	PH	TURB JTU	COLOR UNITS
NUM. VALS.			355	263	218	233	174	306	123	126
AVERAGE			1.1	26.1	3.4	1133.	616.	7.07	2.6	116.
ST. DEV.			1.4	7.8	2.3	480.	480.	0.57	3.7	48.
MIN. VAL.			0.0	19.9	0.2	106.	66.	5.00	0.4	20.
MAX. VAL.			5.0	31.4	8.2	1793.	1580.	7.94	24.0	265.

	STATION CODE	DATE MO/DA/YR	OPO4 MG P/L	TPO4 MG P/L	TDPO4 MG P/L	DORG PO4 MG P/L	TOTORG C MG/L
NUM. VALS.			188	185	160	158	142
AVERAGE			0.013	0.046	0.020	0.014	29.3
ST. DEV.			0.026	0.086	0.027	0.010	9.8
MIN. VAL.			0.002	0.002	0.002	0.010	12.8
MAX. VAL.			0.113	0.974	0.124	0.073	52.7

	STATION CODE	DATE MO/DA/YR	NOX MG N/L	NO2 MG N/L	NO3 MG N/L	NH4 MG N/L	TKN MG N/L	TDKN MG N/L	TOTAL N MG N/L	PART.N MG N/L
NUM. VALS.			186	187	178	187	184	125	183	105
AVERAGE			0.140	0.019	0.128	0.08	3.13	2.22	3.27	1.40
ST. DEV.			0.657	0.055	0.620	0.23	3.07	0.92	3.22	3.83
MIN. VAL.			0.004	0.004	0.004	0.01	0.87	0.54	0.87	0.10
MAX. VAL.			4.822	0.461	4.571	2.46	36.69	5.04	36.71	35.41

	STATION CODE	DATE MO/DA/YR	NA MG/L	K MG/L	CA MG/L	MG MG/L	CL MG/L	SO4 MG/L	ALK MEQ/L	ALKCACO3 MG/L	HARDNESS MG/LCACO
NUM. VALS.			160	160	187	187	188	160	187	187	187
AVERAGE			65.04	3.73	45.09	14.64	104.5	28.1	2.82	141.0	172.6
ST. DEV.			50.95	3.18	36.49	12.50	78.3	30.3	2.28	113.9	141.3
MIN. VAL.			5.32	0.21	2.97	0.79	4.0	5.0	0.10	5.0	1.7
MAX. VAL.			175.50	14.34	138.30	43.48	457.5	137.8	8.13	406.5	523.1

	STATION CODE	DATE MO/DA/YR	TDISS CD MG/L	TDISS CR MG/L	TDISS CU MG/L	TDISS PB MG/L	TDISS MN MG/L	TDISS SR MG/L	TDISS ZN MG/L	TDISS FE MG/L
NUM. VALS.			31	79	79	79	79	31	31	0
AVERAGE			0.001	0.001	0.004	0.002	0.008	0.943	0.027	
ST. DEV.				0.000	0.005	0.002	0.008	0.969	0.006	
MIN. VAL.			0.001	0.001	0.001	0.001	0.001	0.196	0.021	
MAX. VAL.			0.001	0.003	0.031	0.011	0.040	3.312	0.042	

PROJECT CAWO DATE OF PRINTING 04/15/81

PARAMETER RANGE OF VALUES UNITS

DATE 1/ 1/78 - 12/31/79 MO/DA/YR

STATIONS CA2-1 CA2-2 CA2-3 CA2-4 CA2-5
CA2-6 CA2-7 CA2-8 CA2-9 CA2-10
CA2-11 CA2-12 CA2-13 CA2-14 CA2-15
CA2-16 CA2-17 CA2-18 CA2-19 CA2-20
CA2-21

	STATION CODE	DATE MO/DA/YR	DEPTH METERS	TEMP CENT	D.O. MG/L	SP COND UMHOS/CM	LAB COND UMHOS/CM	PH	TURB JTU	COLOR UNITS
NUM. VALS.			185	62	0	21	185	122	101	101
AVERAGE			0.0	27.5		962.	983.	6.84	1.4	93.
ST. DEV.			0.0	1.5		386.	295.	0.48	2.0	36.
MIN. VAL.			0.0	24.7		390.	338.	5.70	0.4	30.
MAX. VAL.			0.0	30.8		2350.	2600.	8.00	18.0	215.

	STATION CODE	DATE MO/DA/YR	OPO4 MG P/L	TPO4 MG P/L	TDPO4 MG P/L	DORG PO4 MG P/L	TOTORG C MG/L
NUM. VALS.			185	185	163	162	158
AVERAGE			0.007	0.028	0.014	0.014	32.9
ST. DEV.			0.014	0.047	0.025	0.012	11.3
MIN. VAL.			0.002	0.002	0.002	0.010	11.4
MAX. VAL.			0.094	0.318	0.157	0.108	96.9

	STATION CODE	DATE MO/DA/YR	NOX MG N/L	NO2 MG N/L	NO3 MG N/L	NH4 MG N/L	TKN MG N/L	TDKN MG N/L	TOTAL N MG N/L	PART.N MG N/L
NUM. VALS.			185	185	181	185	184	122	184	99
AVERAGE			0.018	0.005	0.015	0.05	2.60	2.08	2.62	0.60
ST. DEV.			0.094	0.008	0.087	0.14	0.97	0.70	0.98	0.62
MIN. VAL.			0.004	0.004	0.004	0.01	0.20	0.54	0.10	0.10
MAX. VAL.			1.018	0.087	0.943	1.52	6.80	4.86	6.81	2.59

	STATION CODE	DATE MO/DA/YR	NA MG/L	K MG/L	CA MG/L	MG MG/L	CL MG/L	SO4 MG/L	ALK MEQ/L	ALKCACO3 MG/L	HARDNESS MG/LCACO
NUM. VALS.			164	164	185	185	185	164	184	184	185
AVERAGE			112.17	5.26	66.01	24.29	161.0	34.0	4.80	240.1	264.8
ST. DEV.			40.65	2.09	19.08	7.30	58.3	18.8	1.29	64.3	75.4
MIN. VAL.			35.06	0.97	17.70	6.97	46.4	5.0	1.32	66.0	72.9
MAX. VAL.			338.69	14.42	131.20	43.55	524.3	101.7	9.54	477.0	506.9

	STATION CODE	DATE MO/DA/YR	TDISS CD MG/L	TDISS CR MG/L	TDISS CU MG/L	TDISS PB MG/L	TDISS MN MG/L	TDISS SR MG/L	TDISS ZN MG/L	TDISS FE MG/L
NUM. VALS.			42	63	63	63	63	42	42	0
AVERAGE			0.001	0.001	0.005	0.003	0.009	1.985	0.027	
ST. DEV.				0.000	0.005	0.003	0.009	0.624	0.006	
MIN. VAL.			0.001	0.001	0.001	0.001	0.001	0.478	0.021	
MAX. VAL.			0.001	0.002	0.020	0.012	0.042	4.072	0.051	

TABLE 14. SUMMARY OF WATER CHEMISTRY DATA FOR WATER CONS. AREA 3A 1978-1979

PROJECT CAWQ DATE OF PRINTING 04/15/81

PARAMETER RANGE OF VALUES UNITS

DATE 1/ 1/78 - 12/31/79 MO/DA/YR

STATIONS CA3-1 CA3-2 CA3-3 CA3-4 CA3-5
CA3-6 CA3-7 CA3-8 CA3-9 CA3-10
CA3-11 CA3-12 CA3-13 CA3-14 CA3-15
CA3-16 CA3-17 CA3-18 CA3-19 CA3-20
CA3-21

	STATION CODE	DATE MO/DA/YR	DEPTH METERS	TEMP CENT	D.O. MG/L	SP COND UMHOS/CM	LAB COND UMHOS/CM	PH	TURB JTU	COLOR UNITS
NUM. VALS.			178	34	0	21	157	115	94	93
AVERAGE			0.0	26.8		395.	517.	6.69	2.3	59.
ST. DEV.			0.0	1.6		123.	221.	0.29	2.9	35.
MIN. VAL.			0.0	23.7		240.	176.	6.00	0.4	10.
MAX. VAL.			0.0	29.0		650.	1098.	7.72	16.0	280.

	STATION CODE	DATE MO/DA/YR	OPO4 MG P/L	TPO4 MG P/L	TDPO4 MG P/L	DORG PO4 MG P/L	TOTORG C MG/L
NUM. VALS.			176	178	155	143	134
AVERAGE			0.003	0.015	0.005	0.011	29.9
ST. DEV.			0.003	0.022	0.006	0.003	20.5
MIN. VAL.			0.002	0.002	0.002	0.010	7.3
MAX. VAL.			0.039	0.160	0.052	0.037	117.1

	STATION CODE	DATE MO/DA/YR	NOX MG N/L	NO2 MG N/L	NO3 MG N/L	NH4 MG N/L	TKN MG N/L	TDKN MG N/L	TOTAL N MG N/L	PART.N MG N/L
NUM. VALS.			177	177	176	176	178	112	177	82
AVERAGE			0.014	0.006	0.011	0.04	2.08	1.80	2.09	0.67
ST. DEV.			0.079	0.015	0.064	0.15	1.17	0.79	1.18	1.07
MIN. VAL.			0.004	0.004	0.004	0.01	0.59	0.48	0.60	0.10
MAX. VAL.			1.027	0.201	0.826	1.95	8.41	5.14	8.42	6.75

	STATION CODE	DATE MO/DA/YR	NA MG/L	K MG/L	CA MG/L	MG MG/L	CL MG/L	SO4 MG/L	ALK MEQ/L	ALKCACO3 MG/L	HARDNESS MG/LCACO
NUM. VALS.			155	155	176	176	177	156	177	177	176
AVERAGE			34.96	1.62	63.41	9.13	52.6	17.0	3.72	185.9	195.9
ST. DEV.			24.74	1.26	23.28	6.61	37.1	13.1	1.44	71.9	76.4
MIN. VAL.			4.32	0.20	30.39	0.91	5.9	5.0	0.72	36.0	83.3
MAX. VAL.			108.28	5.42	174.75	31.62	176.4	78.0	10.65	532.5	475.5

	STATION CODE	DATE MO/DA/YR	TDISS CD MG/L	TDISS CR MG/L	TDISS CU MG/L	TDISS PB MG/L	TDISS MN MG/L	TDISS SR MG/L	TDISS ZN MG/L	TDISS FE MG/L
NUM. VALS.			42	42	42	42	42	42	42	0
AVERAGE			0.001	0.001	0.002	0.001	0.010	0.510	0.026	
ST. DEV.					0.001	0.001	0.008	0.448	0.006	
MIN. VAL.			0.001	0.001	0.001	0.001	0.001	0.196	0.021	
MAX. VAL.			0.001	0.001	0.006	0.005	0.034	2.155	0.055	

TABLE 15. Ranking between Water Conservation Areas for Selected Chemical Parameters

	highest →		lowest
Temp.	CA2A(27.5)	CA3A(26.8)	CA1(26.1)
Lab. Cond.	CA2A(983)	CA1(631)	CA3A(517)
pH	CA1(7.10)	CA2A(6.84)	CA3A(6.69)
Turb.	CA1(2.6)	CA3A(2.3)	CA2A(1.4)
Color	CA1(117)	CA2A(93)	CA3A(59)
OPO_4	CA1(.015)	CA2A(.007)	CA3A(.003)
TPO_4	CA1(.047)	CA2A(.028)	CA3A(.015)
$TdPO_4$	CA1(.021)	CA2A(.014)	CA3A(.005)
$DorgPO_4$	CA1(.015)	CA2A(.014)	CA3A(.011)
TorgC	CA2A(32.9)	CA3A(29.9)	CA1(29.3)
NO_x	CA1(.159)	CA2A(.018)	CA3A(.014)
NO_2	CA1(.022)	CA2A(.005)	CA3A(.005)
NO_3	CA1(.144)	CA2A(.015)	CA3A(.011)
NH_4	CA1(.08)	CA2A(.05)	CA3A(.04)
TKN	CA1(2.95)	CA2A(2.60)	CA3A(2.08)
TdKN	CA1(2.22)	CA2A(2.08)	CA3A(1.80)
Total N	CA1(3.23)	CA2A(2.62)	CA3A(2.09)
Part. N	CA1(1.25)	CA3A(0.60)	CA2)(0.67)
Na	CA2A(112.17)	CA1(66.56)	CA3A(34.96)
K	CA2A(5.26)	CA1(3.82)	CA3A(1.62)
Ca	CA2A(66.01)	CA3A(63.41)	CA1(46.31)
Mg	CA2A(24.29)	CA1(15.00)	CA3A(9.13)
Cl	CA2A(161.0)	CA1(105.4)	CA3A(52.6)
SO_4	CA2A(34.0)	CA1(29.5)	CA3A(17.0)
Alk	CA2A(4.80)	CA3A(3.72)	CA1(2.87)
Hardness	CA2A(264.8)	CA3A(195.9)	CA1(177.1)

*All nutrient values in mg/l

Examination of Water Conservation Area water quality distribution can be illustrated by use of SYMAP. SYMAP is a computer mapping program designed to construct a map of concentration gradients set into isopleths to spatially illustrate both similarities and differences in parameter values. The actual sample sites are designed by exact parameter values. For each print location (symbol), the program employs a search radius such that an average of seven data points are included in the interpolation. The interpolation is distance weighted with the data point values received by the print location being inversely proportional to the square of their distance apart. The technique is similar to that used to construct topographical ground elevation maps, isothermal maps, and population density maps. Aside from actual parameter values, there are a number of manipulative factors which can affect the resultant map: the number and location of sample sites, the system's physical boundaries, the selection of contour intervals, etc.

In general, water within the three Water Conservation Areas follows topographical contours, flowing from north to south and from east to west between areas. The exact mechanics of water flow within the areas are largely speculative, due to the great variation in the controlling factors: stage levels, vegetation patterns, and discharge regime. Water of high nutrient content is released into the area during periods of discharge, and the direction and extent to which the high concentration contour extends indicates the flow and degree of influence these discharges have on receiving waters. The extent of influence depends upon a number of variables: the quality and quantity of inflow, the quality of receiving waters, the extent of local biochemical activity, and physical characteristics such as stage level and local topography. The October 1979 sampling trip was selected as a case study in order to demonstrate the manner in which SYMAP depicts areal distribution.

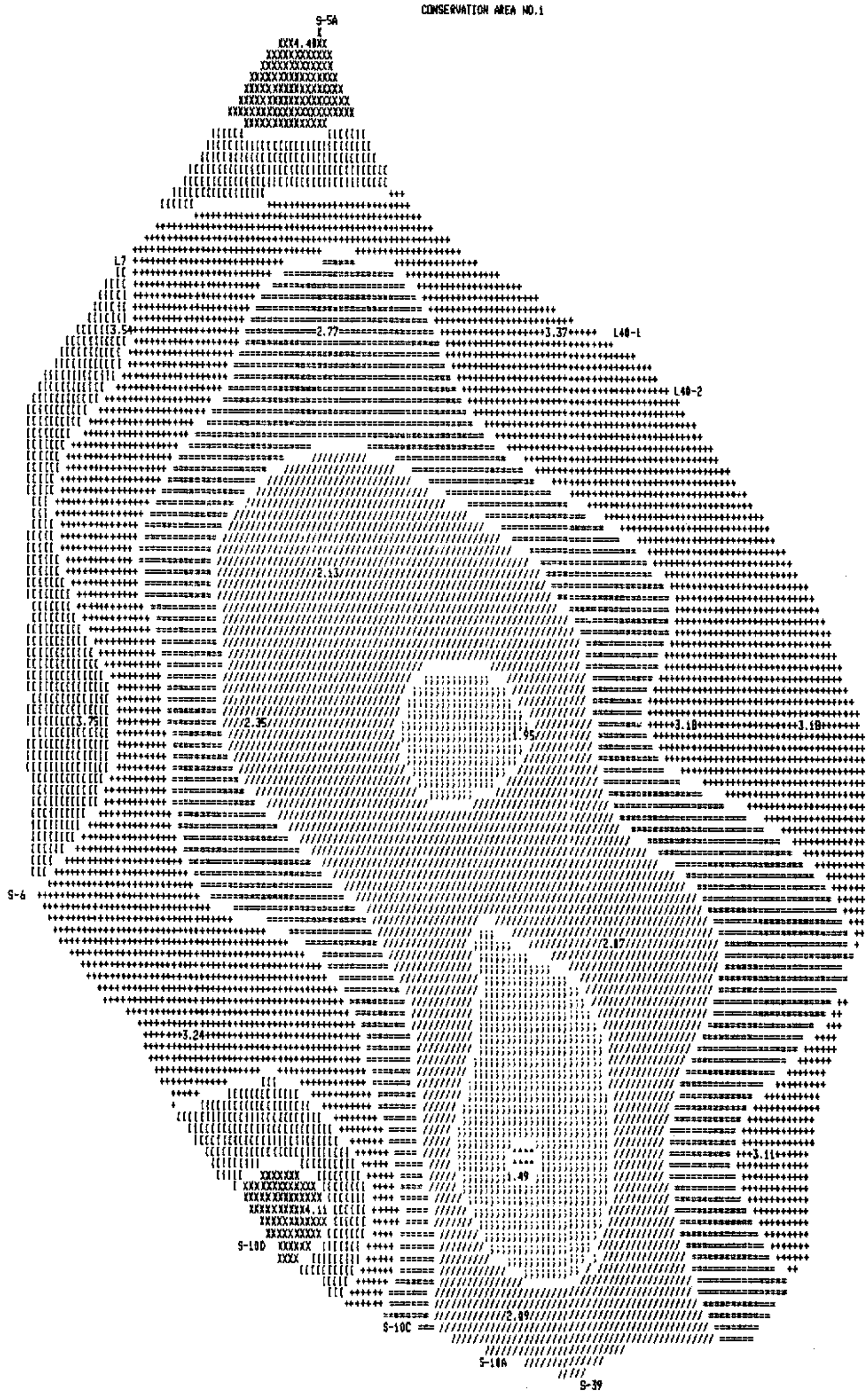
Figures 18 through 26 provide an example of SYMAP$^{(R)}$ concentration gradients for all three of the Water Conservation Areas during October 1979. Table 16 provides stage levels, rainfall estimates, and discharge regimes for each of the Water Conservation Areas for the two week period prior to sampling. October 1979 was a wet month characterized by moderate to heavy discharge by a majority of the Water Conservation Area structures. The stages in all three WCA's were high, approaching the maximum storage value for the 1979 year. This was due to a combination of high rainfall and high discharge rates as documented in the Army Corps of Engineers monthly budget sheets.

The first three maps represent total nitrogen, total phosphorus, and chloride distribution for Water Conservation Area 1 during October 1979. The following six maps are the respective maps for WCA 2A and WCA 3A.

The October SYMAP estimate of areal distribution illustrates relatively low nutrient values in the interior portions of the marsh and more elevated values inside the deeper peripheral canals. This trend was previously documented by Waller (1975).

The three WCA 2A October maps illustrate clearly the influence of a discharge structure on receiving waters. In general, the discharges of the S10 structures do not represent WCA 1 interior marsh water quality as much as they do reflect the water coming down the rim canal from S6 discharges. The influence of these nutrient elevated agricultural inflows is reduced with increased distance from the discharge point.

FIGURE 18. DISTRIBUTION OF TOTAL NITROGEN VALUES IN WATER CONSERVATION AREA 1, OCTOBER 1979



DISTRIBUTION OF TOTAL NITROGEN VALUES IN CONSERVATION AREA 1, OCTOBER 19
DATA VALUE EXTREMES ARE 1.49 4.40
ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
MAXIMUM	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00

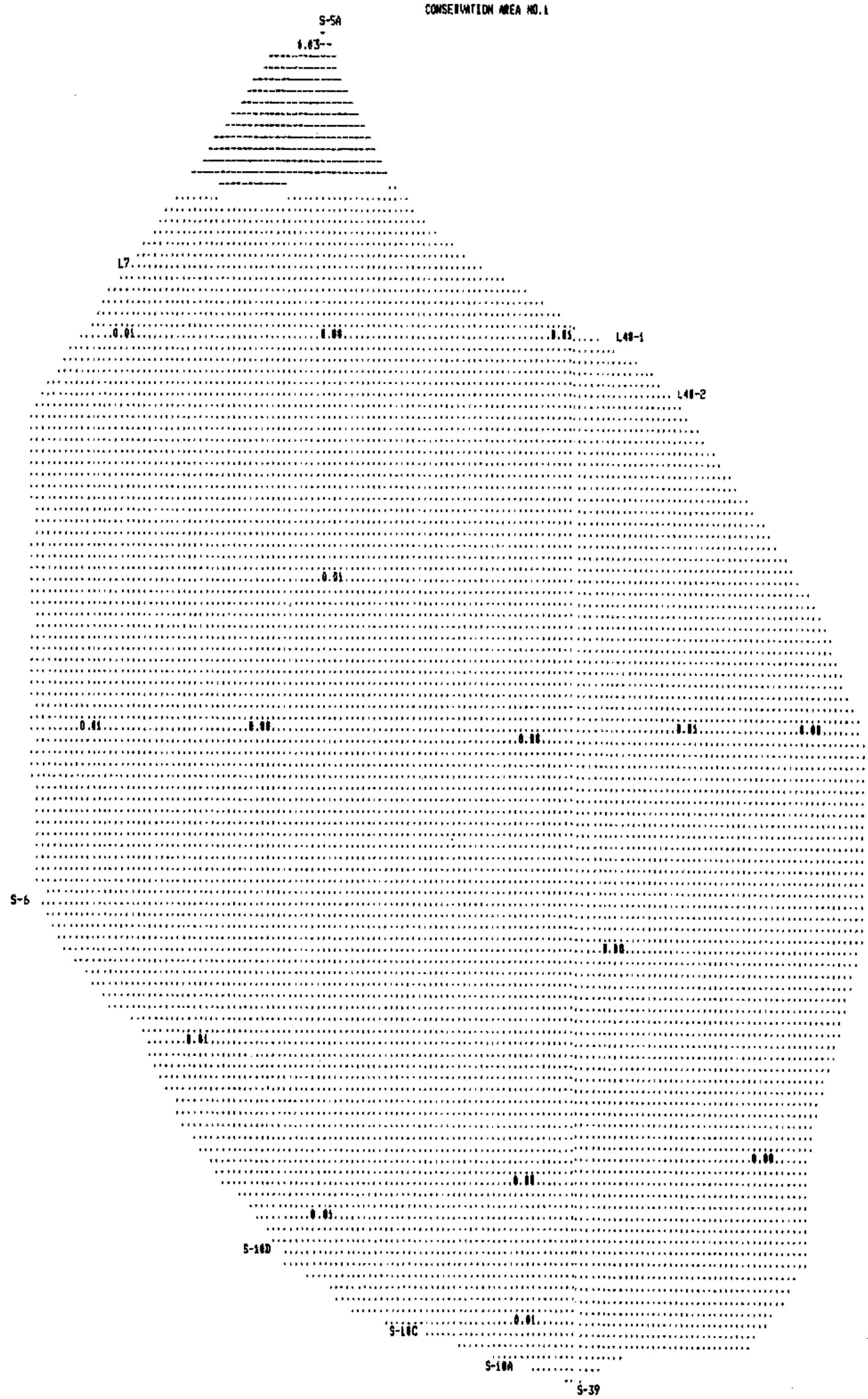
PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

LEVEL	1	2	3	4	5	6	7	8	9	10
SYMBOLS	....	--------	^^^^^^^^	;;;;;;;;	////////	========	++++++++	[[[[[[[[	XXXXXXXX	########

FIGURE 19. DISTRIBUTION OF TOTAL PHOSPHORUS IN WATER CONSERVATION AREA 1, OCTOBER 1979



DISTRIBUTION OF TOTAL PHOSPHORUS IN CONSERVATION AREA 1, OCTOBER, 1979
DATA VALUE EXTREMES ARE 0.00 0.13
ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.01	0.03	0.04	0.06	0.07	0.09	0.10	0.12	0.13
MAXIMUM	0.01	0.03	0.04	0.06	0.07	0.09	0.10	0.12	0.13	0.15

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

LEVEL	1	2	3	4	5	6	7	8	9	10
SYMBOLS	....	--------	********	;;;;;;;;	////////	========	++++++++	[[[[[[[[	XXXXXXXX	########

FIGURE 20. DISTRIBUTION OF CHLORIDE VALUES IN WATER CONSERVATION AREA 1, OCTOBER 1979

DISTRIBUTION OF CHLORIDE VALUES IN CONSERVATION AREA 1, OCTOBER, 1979
DATA VALUE EXTREMES ARE 0.02 156.50
TOTAL MISSING DATA POINTS IS 1
ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00
MAXIMUM	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00	250.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

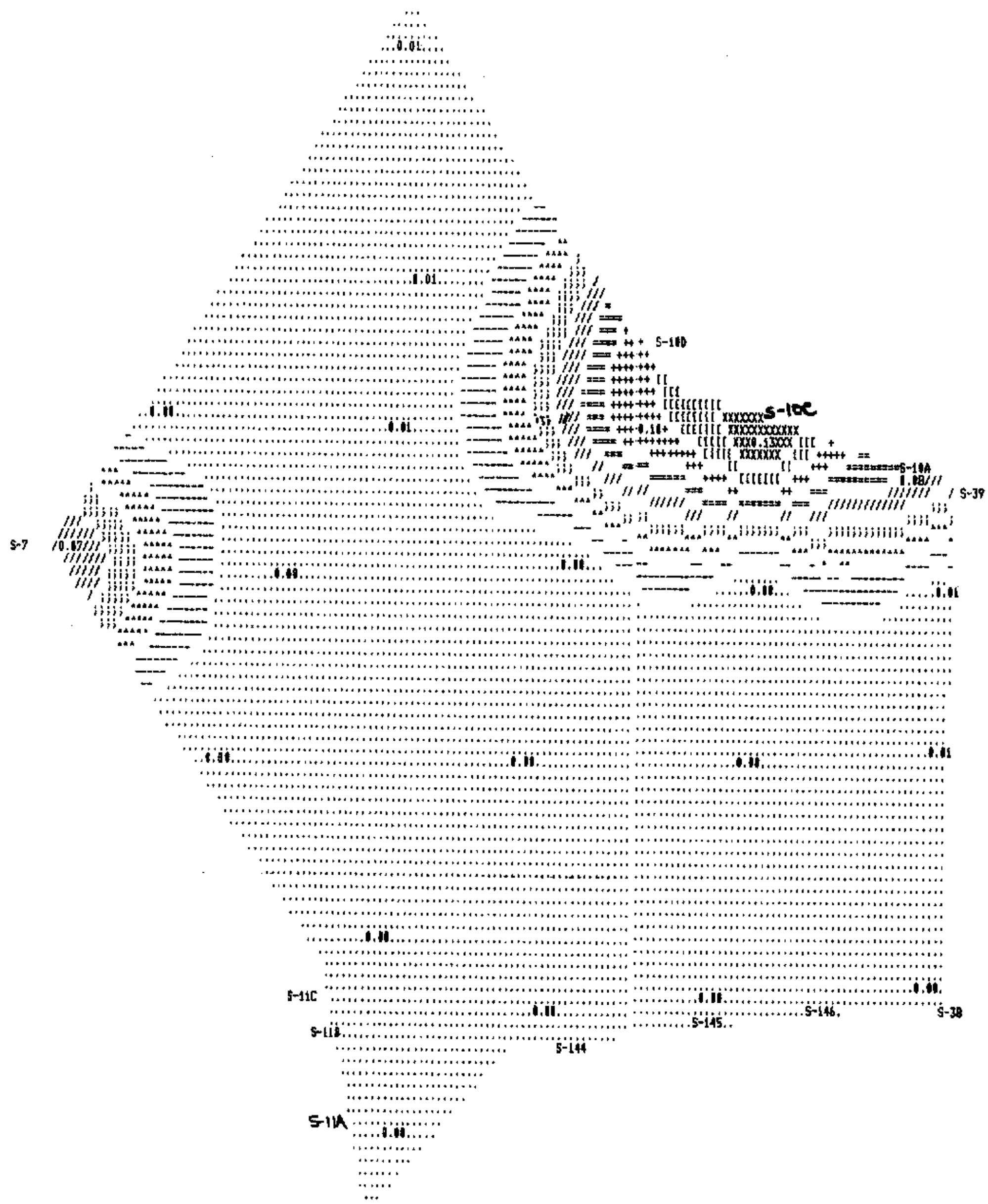
LEVEL	1	2	3	4	5	6	7	8	9	10
SYMBOLS	....	————	AAAAAAAA	;;;;;;;;	////////	========	++++++++	[[[[[[[[	XXXXXXXX	########

FIGURE 21. DISTRIBUTION OF TOTAL NITROGEN VALUES IN WATER CONSERVATION AREA 2A, OCTOBER 1979

DISTRIBUTION OF TOTAL NITROGEN VALUES IN CONSERVATION AREA 2, OCTOBER 19
DATA VALUE EXTREMES ARE 1.20 5.62
ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	ABOVE 5.00
MAXIMUM	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	
PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	
FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL											
LEVEL	1	2	3	4	5	6	7	8	9	10	H
SYMBOLS	....	———	^^^^^^^^^	;;;;;;;;;	/////////	=========	+++++++++	[[[[[[[[[	XXXXXXXXX	#########	WWWWWWWWW

FIGURE 22. DISTRIBUTION OF TOTAL PHOSPHORUS IN WATER CONSERVATION AREA 2, OCTOBER 1979

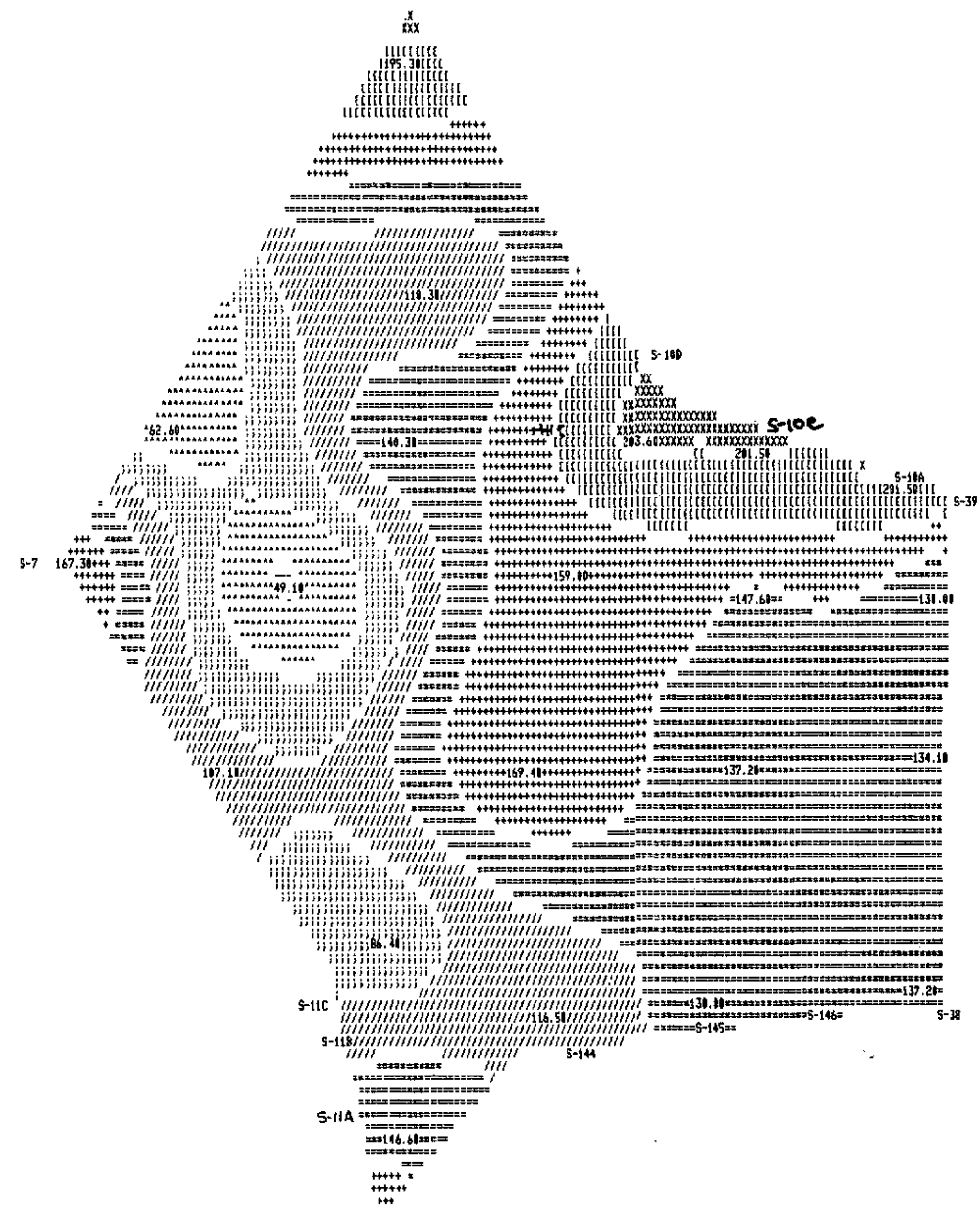


DISTRIBUTION OF TOTAL PHOSPHORUS IN CONSERVATION AREA 2, OCTOBER, 1979
DATA VALUE EXTREMES ARE 0.00 0.13
ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.01	0.03	0.04	0.06	0.07	0.09	0.10	0.12	0.13
MAXIMUM	0.01	0.03	0.04	0.06	0.07	0.09	0.10	0.12	0.13	0.15
PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL LEVEL	1	2	3	4	5	6	7	8	9	10
SYMBOLS	....	———	AAAAAAAA	;;;;;;;;	////////	========	++++++++	[[[[[[[[	XXXXXXXX	########

0.543647 MINUTES FOR MAP

FIGURE 23. DISTRIBUTION OF CHLORIDE VALUES IN WATER CONSERVATION AREA 2A, OCTOBER 1979.



DISTRIBUTION OF CHLORIDE VALUES IN CONSERVATION AREA 2, OCTOBER, 1979
DATA VALUE EXTREMES ARE 49.10 203.60
ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00
MAXIMUM	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00	250.00

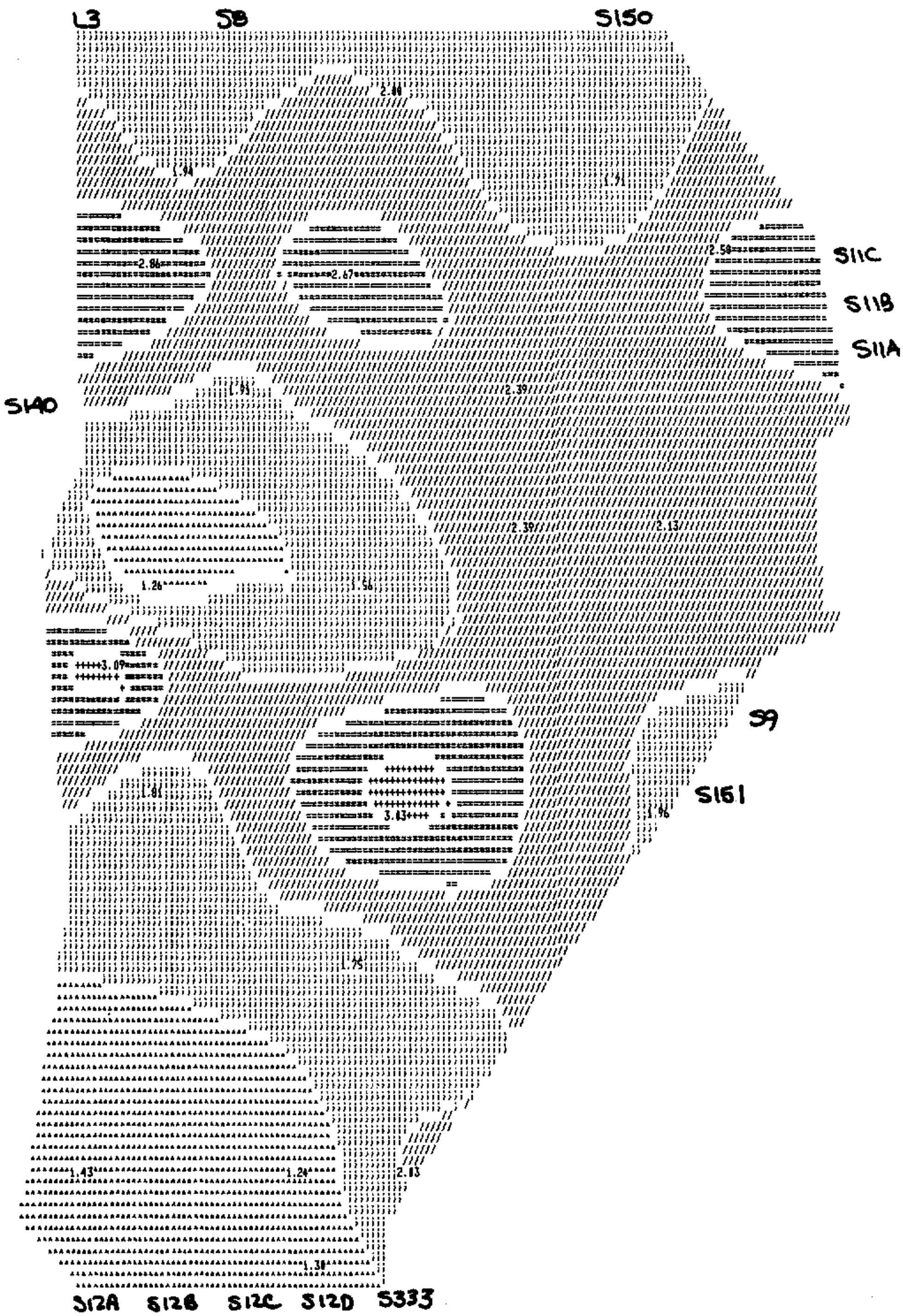
PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

LEVEL	1	2	3	4	5	6	7	8	9	10
SYMBOLS	....	--------	^^^^^^^^	;;;;;;;;	////////	========	++++++++	[[[[[[[[	XXXXXXXX	########

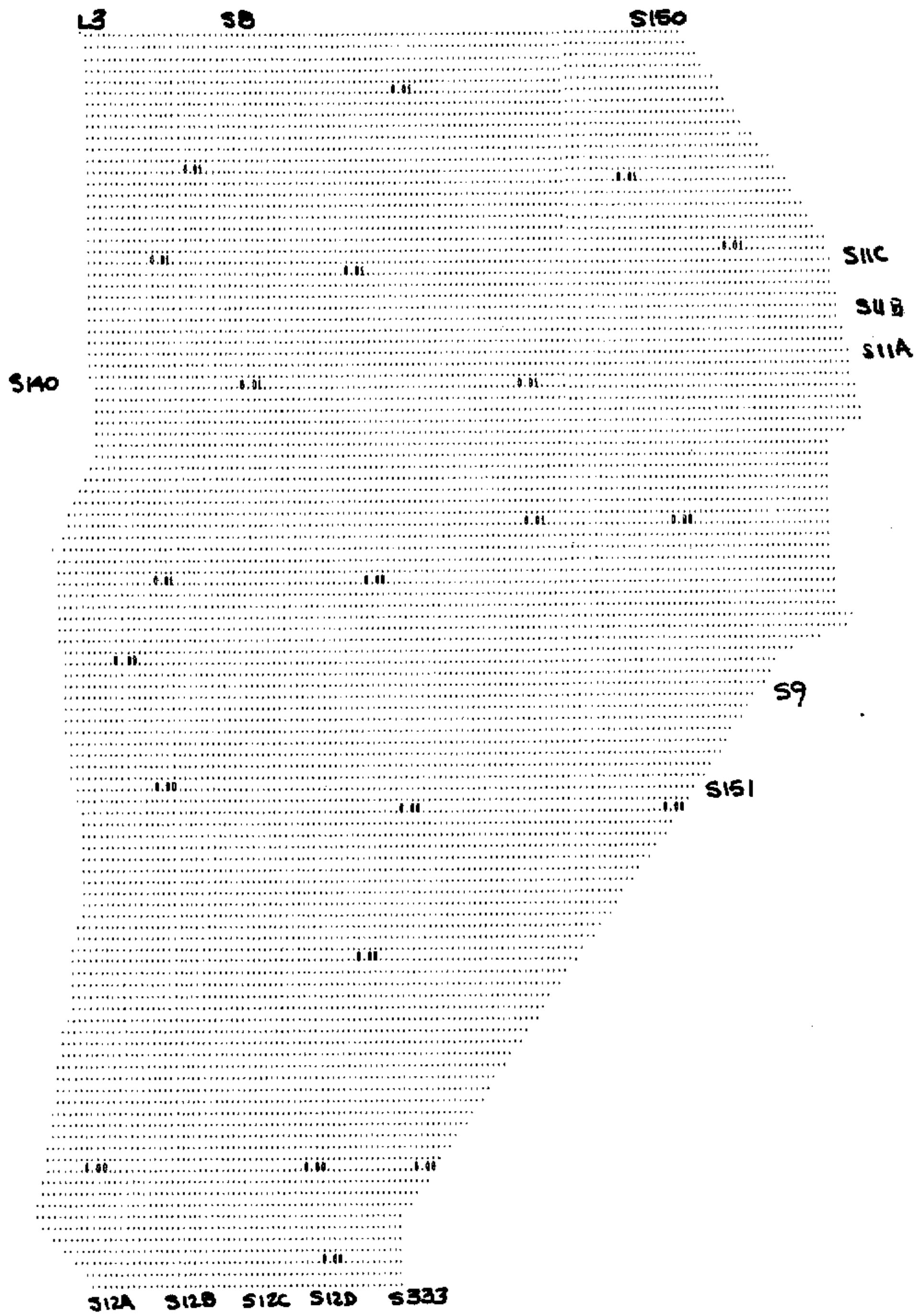
FIGURE 24. DISTRIBUTION OF TOTAL NITROGEN VALUES IN WATER CONSERVATION AREA 3, OCTOBER 1979



DISTRIBUTION OF TOTAL NITROGEN VALUES IN CONSERVATION AREA 3, OCTOBER 1979
DATA VALUE EXTREMES ARE 1.24 3.09
ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
MAXIMUM	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL										
LEVEL	1	2	3	4	5	6	7	8	9	10
SYMBOLS	....	--------	AAAAAAAA	;;;;;;;;	////////	========	++++++++	[[[[[[[[	XXXXXXXX	########

FIGURE 25. DISTRIBUTION OF TOTAL PHOSPHORUS IN WATER CONSERVATION AREA 3A, OCTOBER 1979



DISTRIBUTION OF TOTAL PHOSPHORUS IN CONSERVATION AREA 3, OCTOBER, 1979
DATA VALUE EXTREMES ARE 0.00 0.01
ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	0.01	0.03	0.04	0.06	0.07	0.09	0.10	0.12	0.13
MAXIMUM	0.01	0.03	0.04	0.06	0.07	0.09	0.10	0.12	0.13	0.15

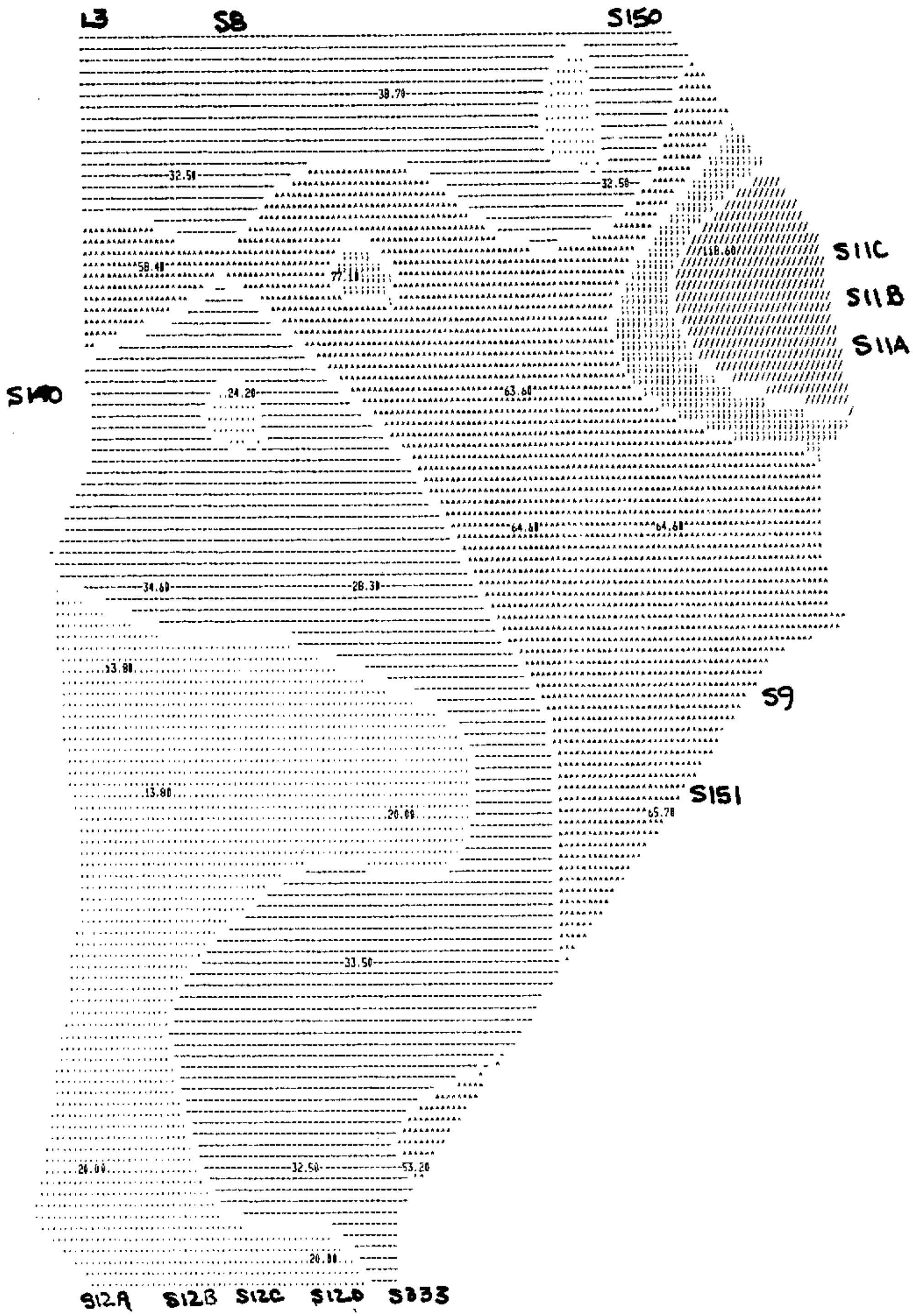
PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

LEVEL	1	2	3	4	5	6	7	8	9	10
SYMBOLS	....	--------	********	;;;;;;;;	////////	========	++++++++	[[[[[[[[	XXXXXXXX	########

FIGURE 26. DISTRIBUTION OF CHLORIDE VALUES IN WATER CONSERVATION AREA 3, OCTOBER 1979



DISTRIBUTION OF CHLORIDE VALUES IN CONSERVATION AREA 3, OCTOBER, 1979
DATA VALUE EXTREMES ARE 13.80 118.60
ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL
('MAXIMUM' INCLUDED IN HIGHEST LEVEL ONLY)

MINIMUM	0.0	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00
MAXIMUM	25.00	50.00	75.00	100.00	125.00	150.00	175.00	200.00	225.00	250.00

PERCENTAGE OF TOTAL ABSOLUTE VALUE RANGE APPLYING TO EACH LEVEL

10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

FREQUENCY DISTRIBUTION OF DATA POINT VALUES IN EACH LEVEL

LEVEL	1	2	3	4	5	6	7	8	9	10
SYMBOLS	....	---------	^^^^^^^^^	:::::::::	/////////	=========	+++++++++	[[[[[[[[[	XXXXXXXXX	#########

TABLE 16. RAINFALL, STAGE LEVELS AND DISCHARGE RATES FOR WCA'S FOR INTERIOR SAMPLING

October 1979	WCA 1		WCA 2A		WCA 3A	
Rainfall		1.53		2.05		0.93
Stage		17.08		14.58		10.24
Inflows	S5	(22,429)	S7	(16,905)	S8	(8,779)
	S6	(13,218)	S10's	(13,971)	S140	(8,565)
					S9	(9,260)
					S150	(0)
	Total Discharge 124,694				S11's	(0)
					S28J	(16,626)
					S3	(14,941)

1. all rainfall and inflow estimates are based on two week period prior to sampling
2. all rainfall estimates in inches (COE)
3. all stages in feet mean sea level (COE)
4. all inflows in acre feet (COE)

A more detailed analysis of the SYMAP will be addressed in the final report.

In most general terms, the Water Conservation Areas could theoretically act as one large, modified aquatic system. By conjecture, water discharged into WCA 1 at the northeast corner (S5A) could find its way down the WCA 1, WCA 2A, WCA 3A pathway and out the southwest corner (S12A). The actual possibility of this happening is remote due to the large number of inflow/outflow points and the general complexity of the system. The S5A input, however, represents agricultural waters of high nutrient concentration as compared to the more nutrient lean waters which exist in the system through the S12A structures.

Figures 27 through 29 provide a comparison between the two extremes. Total nitrogen, total phosphorus, and chlorides are examined for both 1978 and 1979. The average nitrogen value exhibited at the S-12A structure was only 29% of the corresponding value for the S5A sampling station. Similarly, S12A displayed phosphorus and chloride averages at levels 8% and 14% of respective S5A concentrations. A comparison of flow weighted concentrations will further highlight these extremes in water quality. The flow weighted concentration for nitrogen was 7.87 mg/L for S5A as compared with 0.15 mg/L for S-12A. Similarly, the flow weighted concentrations for total phosphorus was 0.14 mg/L and 0.001 mg/L, and chloride flow weighted concentrations were 247.56 mg/L and 1.44 mg/L for S5A and S12A, respectively.

The ability of a marsh to act as a purification system has been well documented by a variety of authors in a variety of locales. Several studies, including Federico, et al (1978), Greig (1976), and Spangler, et al (1976), have recorded extensive nutrient uptake into the biomass; however,

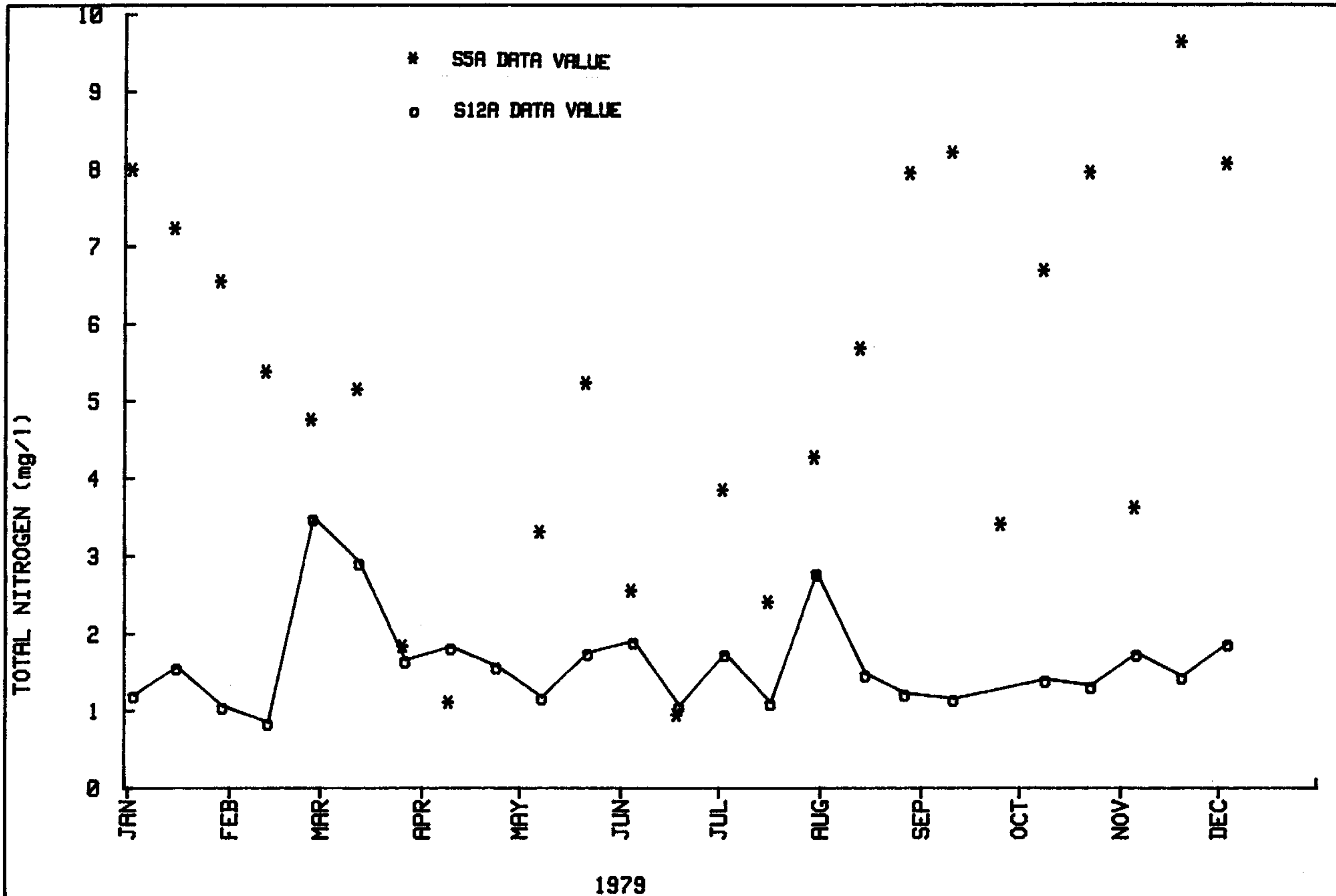


FIGURE 27. COMPARISON OF S5A AND S12A NITROGEN DATA FOR 1979

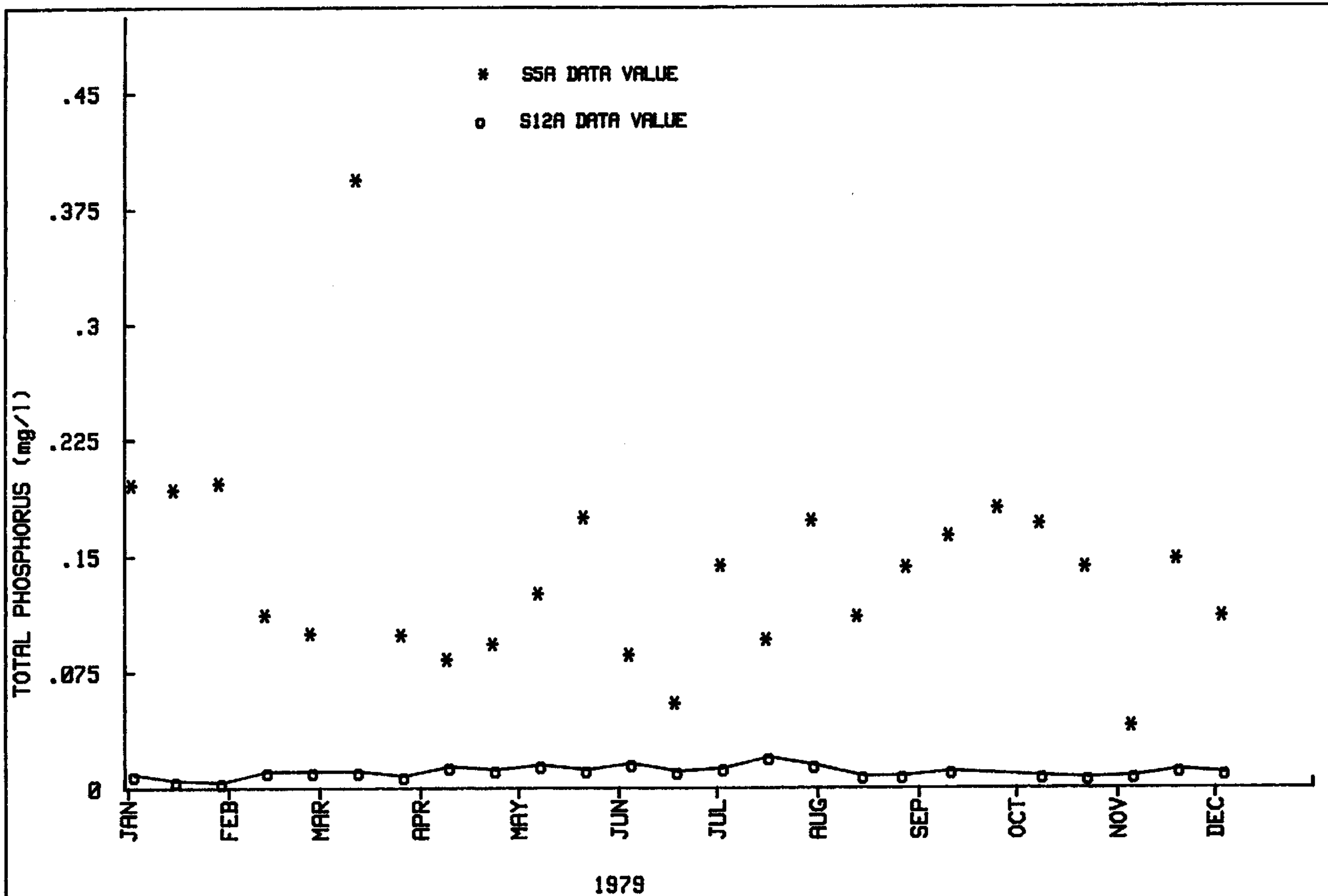


FIGURE 28. COMPARISON OF S5A AND S12A TOTAL PHOSPHORUS DATA FOR 1979

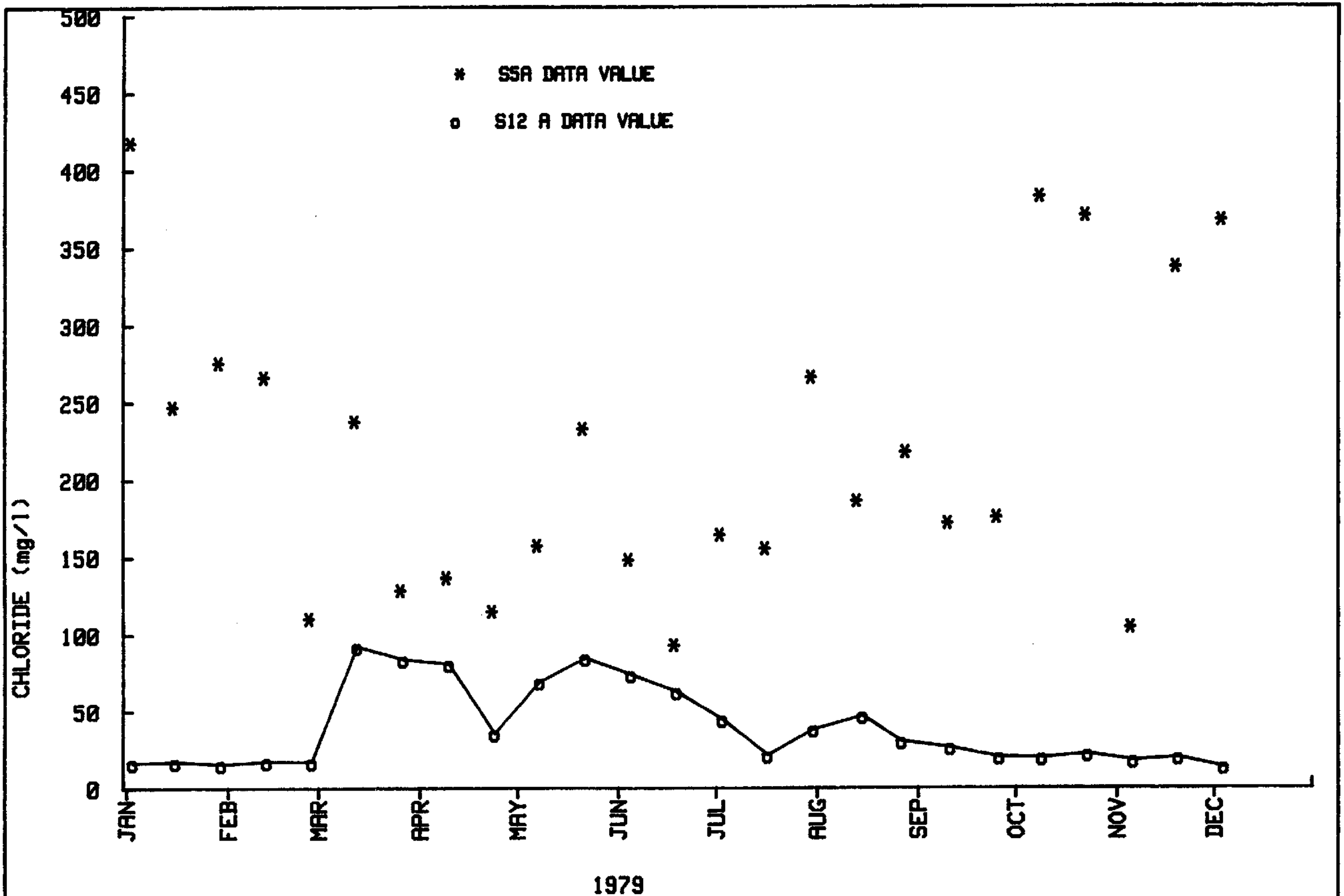


FIGURE 29. COMPARISON OF S5A AND S12A CHLORIDE DATA FOR 1979

these studies go on to indicate a later release of these nutrients in their organic form during spring runoff especially in flow-through systems. Therefore, nitrogen and phosphorus retentions are typically a seasonal phenomenon - taken up into the biomass during the growing season, stored in detritus during the winter months, and then released during the spring flush.

The Water Conservation Areas, however, represent a different case. The primary purpose of the areas is for the storage of water. As a result of water management practices, the areas are not flow-through systems as were the marshes of the Spangler, Greig, and Federico studies. Also the majority of the WCA remains inundated throughout the year, whereas in the other studies the marshes experienced seasonal dry periods. The Federico et al. study, which also investigated nutrient retentions in South Florida (Chandler Slough), measured phosphorus retentions averaging 22% for this two year study as compared with 63%, 86%, and 91% for WCA 1, 2A, and 3A, respectively. Nitrogen retentions in Chandler Slough were calculated at less than 5% whereas WCA 1, 2A, and 3A reported two year average nitrogen retentions of 55%, 56% and 72%, respectively. As previously mentioned, the Chandler Slough is a flow-through marsh which experiences a definite seasonal hydrologic cycle. Retention rates would be strongly affected by this cycle as well as the types of vegetation these seasonal hydrologic fluctuations would produce.

Summary

(1) The quality of water being discharged is largely a function of the land use of the drainage basin. Agricultural waters tend to be high in most of the chemical parameters measured. The sample sites located on the north side of the Water Conservation Areas, draining the Everglades Agricultural Area, consistently exhibit the highest nutrient loadings.

(2) The quality of water inside the Water Conservation Areas and adjacent to inflow points is not only affected by the quality and quantity of water entering the system, but also by the function of the physical design of the system, and the stage and quality of receiving waters.

(3) Rainfall is a considerable contributor of phosphorus and a moderate contributor of nitrogen to the Water Conservation Areas. The nutrient concentrations are low, but the quantity is large enough so that the resultant loads are substantial.

(4) In general, the Water Conservation Areas are functioning well as a natural filtration system. Input loads are large, but there is evidence of high retention and uptake rates.

APPENDIX A

ANALYTICAL METHODS

3/6/80 L.C.

SOUTH FLORIDA WATER MANAGEMENT DISTRICT
Water Chemistry Laboratory
Analytical Methods

AutoAnalyzer II Method

Determination	Method	Range	Sensitivity	Detection Limit
Alkalinity	Colorimetric Automated Methyl Orange, Technicon AA II Method # 111-71W, modified EPA Method #310.2	0-5.0 meq/l	0.1 meq/l	0.1 meq/l
Ammonia	Colorimetric Automated Phenate, Technicon AA II Method #154-71W, modified EPA Method #350.1	0-0.50 mg/l	0.01 mg/l	0.01 mg/l
Chloride	Colorimetric Automated Ferricyanide, Technicon AA II Method #99-70W, modified EPA Method #325.2	0-200.0 mg/l	2.0 mg/l	4.0 mg/l
Nitrite	Colorimetric Automated Diazotization with Sulfanilamide and coupling with N-(1 naphthyl) ethylenediamine dihydrochloride, Technicon colorimetric, automated AA II Method #120-70W, modified EPA Method # 353.2	0-0.200 mg/l	0.002 mg/l	0.004 mg/l
Nitrate	Same as nitrite with Cadmium Reduction Column. Technicon AA II Method #100-70W, modified EPA Method #353.2	0-0.200 mg/l	0.002 mg/l	0.004 mg/l
Total Kjeldahl Nitrogen	Colorimetric, Semi-automated Block Digestor, Technicon AA II Method #376-75W, 334-74A, modified EPA Method #351.2	0-10.0 mg/l	0.1 mg/l	0.20 mg/l
Ortho Phosphate	Colorimetric, Automated, Phosphomolybdenum Blue Complex with Ascorbic Acid Reduction, Technicon AA II Method #155-71W, modified EPA Method #365.1	0-0.10 mg/l	0.001 mg/l	0.002 mg/l
Total Phosphate	Colorimetric, Semi-automated Persulfate Digestion followed by same method as Ortho Phosphate Technicon AA II Method #155-71W, modified EPA Method #365.1	0-0.10 mg/l	0.001 mg/l	0.002 mg/l
Silicates	Colorimetric, Automated Ascorbic Acid Reduction of Silicomolybdate Complex, Technicon AA II Method #105-71W	0-20.0 mg/l	0.20 mg/l	0.40 mg/l
Sulfate	Colorimetric, Automated Methylthymol Blue, Technicon AA II Method #118-71W, modified EPA Method #375.2	0-250.0 mg/l	5.0 mg/l	5.0 mg/l

AutoAnalyzer II Method (Continued)

Determination	Method	Range	Sensitivity	Detection Range
Total Dissolved Iron	Colorimetric, Automated TPTZ Complex with thioglycolic acid pretreatment, Techicon AA II Method #109-71W	0-1.0 mg/l	0.02 mg/l	0.02 mg/l
Total Iron	Colorimetric, Semi-automated, Hydrochloric Acid Digestion modified Standard Methods 13th Ed., pp 192, 1971, followed by Total Dissolved Iron Determination	0-1.0 mg/l	0.02 mg/l	0.02 mg/l

Physical Parameters

Determination	Method	Range	Detection Range
Suspended Solids	Gravimetric Standard Methods Procedure #208D, 14th Ed., pp 94, 1975, EPA Methods #160.1 to 160.4	20-20,000 mg/l	1.0 mg/l or 5% whichever is greater
pH	Electrometric, EPA Method #150.1	0-14 pH	(sensitivity 0.01 pH)
Turbidity	Nephelometric, Standard Methods #214A, 14th Ed., pp 132, 1975, EPA Method #180.1	0-1,000 N.T.U.	2% of scale used
Color	Colorimetric, modified Standard Method #204A, 14th Ed., pp 64, 1975 (modified as per N.C.A.S.I. Technical Bulletin # 253) modified EPA Method #110.2	0-500 mg/l as platinum in platinum-cobalt solution	1.0 mg/l
Conductivity	Electrometric, Specific Conductance at 25^{o}C, modified Standard Methods #205, 14th Ed., pp 71, 1975, modified EPA Method #120.1		

Miscellaneous

Determination	Method	Range	Detection Range
Fluoride	Potentiometric, Ion Selective Electrode, Standard Methods #414B, 14th Ed., pp 391, 1975, EPA Method #340.2	0-2.0 mg/l	.04 mg/l

Metals - Major Cation

Atomic Absorption

Determination	Method	Range	Detection Range
Sodium	Atomic Absorption Direct Aspiration with Dual Capillary System (DCS), EPA Method #273.1	0-150 mg/l	As calculated from absorbance
Potassium	Atomic Absorption Direct Aspiration with Dual Capillary System (DCS), EPA Method #258.1	0-10 mg/l	As calculated from absorbance
Calcium	Atomic Absorption Direct Aspiration with Dual Capillary System (DCS), Samples are treated with La_2O_3/HCl with DCS, EPA Method #215.1	0-150 mg/l	As calculated from absorbance
Magnesium	Atomic Absorption Direct Aspiration with Dual Capillary System (DCS), Same treatment as calcium, EPA Method #242.1	0-40 mg/l	As calculated from absorbance

Trace Metals

Determination	Method	Range
Zinc	Atomic Absorption, Direct Aspiration, EPA Method #289.1	0-1.0 mg/l
Strontium	Atomic Absorption, Direct Aspiration, Standard Methods #321A, 14th Ed., 1975	0-10.0 mg/l
Lead	Atomic Absorption, Furnace Technique, EPA Method #239.2	0-0.020 mg/l
Cadmium	Atomic Absorption, Furnace Technique, EPA Method #213.2	0.0.002 mg/l
Manganese	Atomic Absorption, Furnace Technique, EPA Method #243.2	0-0.010 mg/l
Cobalt	Atomic Absorption, Furnace Technique, EPA Method #219.2	0.0.020 mg/l
Chromium	Atomic Absorption, Furance Technique, EPA Method #218.2	0-0.010 mg/l
Nickel	Atomic Absorption, Furnace Technique, EPA Method #249.2	0-0.020 mg/l
Copper	Atomic Absorption, Furnace Technique, EPA Method #220.2	0-0.020 mg/l

Trace Metals (Continued)
Atomic Absorption

Determination	Method	Range
Arsenic	Atomic Absorption, Furnace Technique, EPA Method #206.2	0-0.010 mg/1
Mercury	Atomic Absorption, Manual Cold Vapor Technique, Modified EPA Method #245.1	0-0.004 mg/1

LC 3/10/80

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Water Chemistry Laboratory

Description of Analytical Methods

Parameter Code	Parameter Name	Comments
NO_x	Nitrate & Nitrite	AutoAnalyzer measured parameter.
NO_2	Nitrite	AutoAnalyzer measured parameter.
NO_3	Nitrate	Calculated parameter. Difference between NO_x and NO_2. When difference is less than limits of detection for NO_x or NO_2 but greater than zero, results are given as limits of detection. When difference is less than zero, no value is printed.
NH_4	Ammonia	AutoAnalyzer measured parameter.
TKN	Total Kjeldahl Nitrogen	AutoAnalyzer measured parameter. Total nitrogen analyses is performed on unfiltered aliquot of sample.
Total N	Total Nitrogen	Sum of TKN and NO_x. When either parameter is reported as limit of detection, the detection value is used in the addition.
TDKN	Total Dissolved Kjeldahl Nitrogen	AutoAnalyzer measured parameter. Total nitrogen analysis is performed on a filtered aliquot of sample.
D Org N	Dissolved Organic Nitrogen	Calculated parameter. Difference between D Org N and NH_4. Calculation exceptions same as for NO_3.
Part N	Particulate Nitrogen	Calculated parameter. Difference between TKN and TDKN. Calculation exceptions same as for NO_3.
TKN-NH_4	Total Kjeldahl Nitrogen corrected for Ammonia	Calculated parameter. Difference between TKN and NH_4. Calculation exceptions same as for NO_3.
NO_x+NH_4	Total Inorganic Nitrogen	Calculated parameter. Sum of NO_x and NH_4. Calculation exceptions same as for Total N.
O-PO_4	Ortho Phosphate	AutoAnalyzer measured parameter.
T-PO_4	Total Phosphate	Total phosphate analysis is performed on unfiltered aliquot of sample.

Parameter Code	Parameter Name	Comments
$TDPO_4$	Total Dissolved Phosphate	AutoAnalyzer measured parameter. Total phosphate analysis is performed on filtered aliquot of sample
D Org PO_4	Dissolved Organic Phosphate	Calculated parameter. Difference between $TDPO_4$ and O-PO_4. Calculation exceptions same as for NO_3.
Part P	Particulate Phosphate	Calculated parameter. Difference between T-PO_4 and $TDPO_4$. Calculation exceptions same as for NO_3.
Acid PO_4	Acid Hydrolyzable Phosphate	AutoAnalyzer measured parameter. Phosphate analyses is performed on unfiltered aliquot of sample after digestion with weak hydrochloric acid (special order only).
Na	Sodium	Atomic Absorption measured parameter.
K	Potassium	Atomic Absorption measured parameter.
Ca	Calcium	Atomic Absorption measured parameter.
Mg	Magnesium	Atomic Absorption measured parameter.
Cl	Chloride	AutoAnalyzer measured parameter.
SO_4	Sulfate	AutoAnalyzer measured parameter.
SiO_2	Silicate	AutoAnalyzer measured parameter.
Alk	Methyl Orange Alkalinity	AutoAnalyzer measured parameter reported as milliequivalent per liter.
Alk $CaCO_3$	Methyl Orange	Calculated parameter. Alkalinity reported as parts per million calcium carbonate. Calculated by multiplying milliequivalent/liter by 50, the equivalent weight in milligrams of $CaCO_3$.
Hardness	Total Hardness	Calculated parameter from sum of calcium and magnesium reported as ppm calcium carbonate
Total Fe	Total Iron	AutoAnalyzer measured parameter. Iron analysis on unfiltered aliquot of sample after digestion with hot hydrochloric acid.
T. Diss. Fe	Total Dissolved Iron	AutoAnalyzer measured parameter. Iron analysis on filtered aliquot of sample preserved with 1% concentrated nitric acid.

Parameter Code	Parameter Name	Comments
TOC	Total Carbon	Measured parameter. Total carbon analysis is performed on unfiltered aliquot of sample preserved with concentrated hydrochloric acid to a pH of <2.0.
Inorg C	Inorganic Carbon	Measured parameter. Inorganic analysis of separate aliquot not acidified. (Special order only).
Org C	Organic Carbon	Calculated parameter. Difference between Total C and inorganic C. Calculation exceptions same as for NO_3.
Tot. Sold.	Total Suspended Solids	Gravimetrically measured parameter. Weight of filterable residue after drying at 104°C.
Fxd. Sold.	Fixed Suspended Solids	Gravimetrically measured parameter. Weight of filterable residue after drying at 550°C.
Vol. Sold.	Volatile Suspended Solids	Calculated parameter. Difference between total and fixed solids. Calculation exceptions same as for NO_3.

NOTE: For calculated parameters if one or more of the necessary measured parameters is missing, no calculations will be done.

APPENDIX B

LAND USE ANALYSIS OF EAA, S5A,
S6, S7, AND S-8 DRAINAGE BASINS

TABLE B-1. BREAKDOWN OF S5A DRAINAGE BASIN LAND USE AND LAND COVER INVENTORY

Classification	Area (in acres)	Percent Impervious	Impervious area (in acres)
(U) Urban & Built-Up Land			
(UR) Residential			
(URSL) Low density	384	20	77
(URSM) Med. density	364	50	182
(URMF) Multi-family	107	80	86
(URMH) Mobile home	9	24	2
TOTAL (UR)	864		347
(UC) Commercial & Service			
(UCSS) Sales & service	120	85	102
TOTAL (UC)	120		102
(UI) Industrial	270	75	203
(US) Institutional			
(USED) Education	40	26	10
(USGF) Government	16	80	13
TOTAL (US)	56		23
(UT) Transportation			
(UTAG) Grass Airport	12	0	0
(UTSP) Sewerage plant	40	15	6
TOTAL (UT)	52		6
(UO) Open & Others			
(UORC) Recreation	80	5	4
(UOPK) Parks	18	5	1
(UOUD) Under development	11	5	1
(UOUN) Open & undeveloped	68	5	3
TOTAL (UO)	177		9
(A) Agricultural			
(AC) Cropland	2390	0	0
(ACSC) Sugarcane	92915	0	0
(ACTC) Truck crops	6066	0	0
(AMSF) Sod farms	1870	0	0
(APIM) Improved pasture	11636	0	0
TOTAL (A)	114877		0

TABLE B-1. (CONTINUED)

Classification	Area (in acres)	Percent Impervious	Impervious area (in acres)
(R) Rangeland			
(RG) Grass	4536	0	0
TOTAL (R)	4536		0
(W) Wetlands			
(WN) Non-forested fresh	8954	0	0
TOTAL (W)	8954		0
(H) Water			
(HC) Canals	340	100	340
(HO) Open	13	100	13
TOTAL (H)	353		353
(B) Barren Land			
(BP) Gravel pits	102	0	0
(BL) Levees	98	0	0
TOTAL (B)	200		0

Total Area 130,459 acres

Total Impervious Area 1,043 acres

Total % of Impervious Area 1%

TABLE B-2. BREAKDOWN OF S6 DRAINAGE BASIN LAND USE AND LAND COVER INVENTORY

Classification	Area (in acres)	Percent Impervious	Impervious area (in acres)
(U) Urban & Built-Up Land			
(UT) Transportation			
(UTSP) Sewerage plant	46	15	7
(UTAG) Grass airport	14	0	0
TOTAL (UT)	60		7
(A) Agriculture			
(ACSC) Sugarcane	31187	0	0
(ACTC) Truck crops	12765	0	0
(APIM) Improved pasture	37509		0
TOTAL (A)	81461		0
(F) Forested Uplands			
(FMOF) Old fields	112	0	0
TOTAL (F)	112		0
(W) Wetlands			
(WN) Non-forested	5638	0	0
TOTAL (W)	5638		0
(H) Open Water			
(HC) Canals	316	100	316
TOTAL (H)	316		316

Total Area 87,587 acres

Total Impervious Area 323 acres

Total % of Impervious Area 0%

TABLE B-3. BREAKDOWN OF S7 DRAINAGE BASIN LAND USE AND LAND COVER INVENTORY

Classification	Area (in acres)	Percent Impervious	Impervious area (in acres)
(U) Urban & Built-Up Land			
(UT) Transportation	1	5	0
(UI) Industrial	47	75	35
(A) Agriculture			
(ACSC) Sugarcane	56930	0	0
(APIM) Improved pasture	7055	0	0
TOTAL (A)	63985		0
(F) Forested Uplands			
(FMOF) Old fields	2001	0	0
TOTAL (F)	2001		0
(W) Wetlands			
(WN) Non-forested	16120	0	0
TOTAL (W)	16120		0
(H) Water			
(HC) Canals	298	100	298
(HO) Open	12	100	12
TOTAL (H)	310		310
Total Area	82,464 acres		
Total Impervious Area	345 acres		
Total % of Impervious Area	0%		

TABLE B-4. BREAKDOWN OF S8 DRAINAGE BASIN LAND USE AND LAND COVER INVENTORY

Classification	Area (in acres)	Percent Impervious	Impervious area (in acres)
(A) Agriculture			
(ACSC) Sugar cane	22,343	0	0
(APIM) Improved pasture	1,232	0	0
TOTAL (A)	23,575		0
(W) Wetlands			
(WN) Non-forested	68,953	0	0
TOTAL (W)	68,953		0
(H) Water			
(HC) Canal	191	100	191
(HO) Open	4	100	4
TOTAL (H)	195		195

Total area	92,723 acres
Total Impervious Area	195 acres
Total % of Impervious Area	0%

APPENDIX C

LOADING PROGRAM, CHEM 11

SFWMD

PROGRAM CH11

PROGRAMMER: Don Paich

PURPOSE:

The main purpose of this program is to calculate material loadings by combining flow rates at a particular site for a specific time period with chemical data at the same site for the same time period. Chemistry data, unlike hydrology data, is not available at a daily frequency. Therefore, two chronologically successive chemistry data points are averaged to give an estimate value for the time period between these two points. This average is then used in conjunction with daily flow data within this time period to compute the daily loadings.

The hydrology flow data is obtained as an output tape from E034 (QCALC) for a specific time interval at a particular hydrology station or station. The chemistry data is obtained from a temporary disk file created by CH07 (CHEM7) which selects data from this particular chemistry station for the same time interval.

DISKS: 6500, 3006.

TAPES: 01 = input hydrology data from E034. (Only if applicable.)

CONTROL CARDS:

```
$JOB,8042-303,CH11,15,,,                               CH11
$DUMP
$RONL,854/6500

$FET,CHEMNUT,CHEMDATA,4064
$OPEN,2
$RAT,841/3006
$FET,CNUT,FILE03,4096
$RELEASE,ALL
$ALLOCATE,1000
$OPEN,3
$FET,NAMEIT,CHEMSUB
$OPEN,4
$FET,CH11,CHEMNUT,960
$OPEN,20
$LOAD,4,20
$RUN
(data)
```

DATA INPUT:

(1) Option card (required).
(2) Hydrology-discharge replacement (optional).
(3) Additional hydrology-discharge (optional).
(4) Loading card (required).
(5) Above sequence may be repeated for multi-job run.

ERROR MESSAGES: CHEMNUT ERROR NO. X

x=1: More than 50 hydrology-discharge replacement cards.
x=2: Required loading card not entered.

01/25/79:ets (previous 12/14/76)

JOB CH11 PROGRAMMER: Don Paich

DISKS: 6500,3006

TAPES: 01 = Input Hydrology Data

CONTROL CARDS:

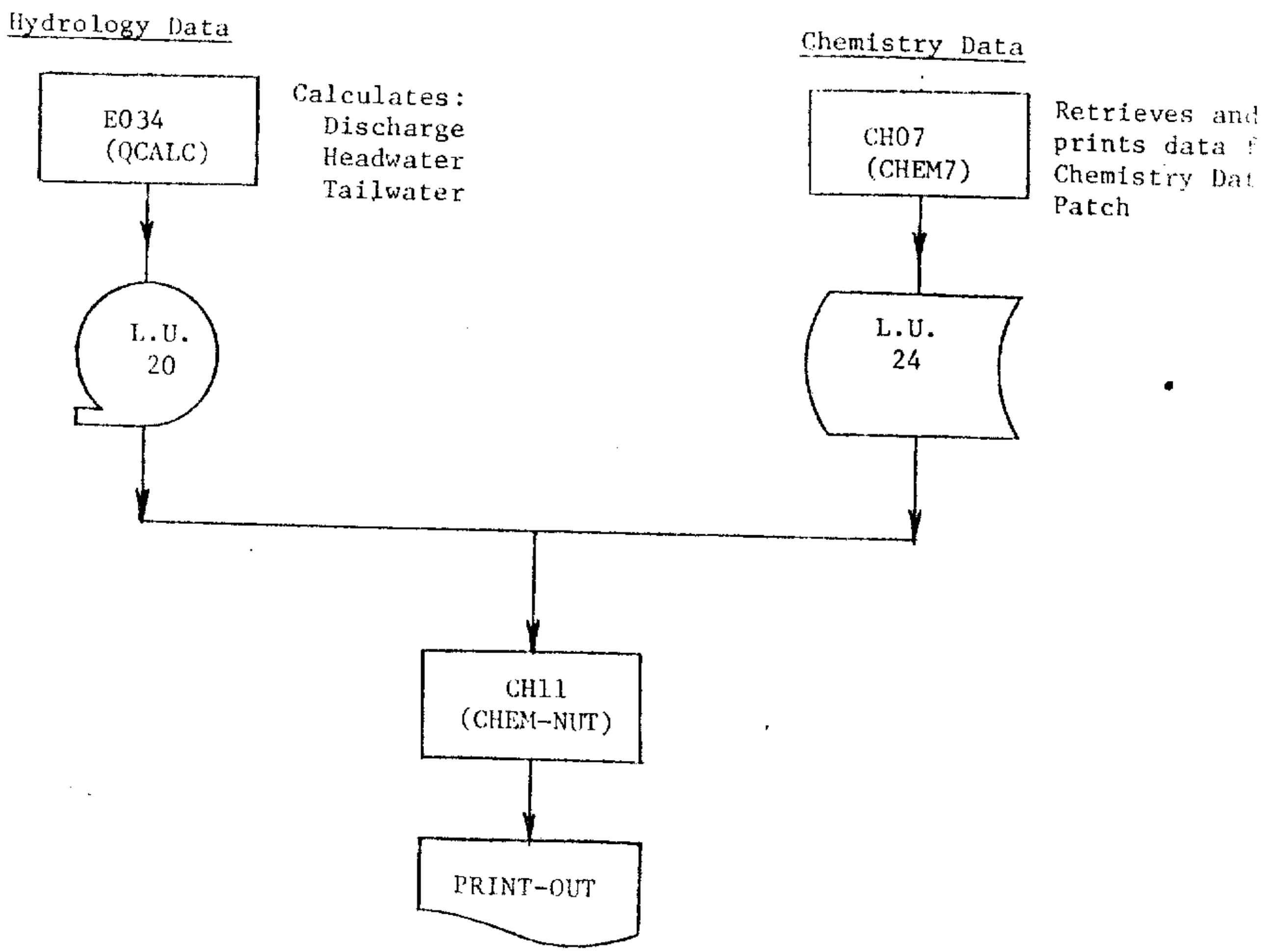
```
$JOB,8042-303,CH11,15,,,          CH11
$DUMP
$RONL,854/6500

$FET,CHEMNUT,CHEMDATA,4064
$OPEN,2
$RAT,841,3006
FET,CNUT,FILE03,4096
$RELEASE,ALL
$ALLOCATE,1000
$OPEN,3
$FET,NAMEIT,CHEMSUB
$OPEN,4
$FET,CH11,CHEMNUT,960
$OPEN,20
$LOAD,4,20
$RUN
(DATA)
```

OPERATING INSTRUCTIONS: Run as normal job

RECOVERY PROCEDURES: Rerun as necessary

TIMING: Dependent on number of parameters (10-45 minutes)



CHEM-NUT INPUT

1. Set-up card (required)

2. Hydrology discharge data replacement card(s) (optional)

   END

3. Additional Hydrology-discharge card(s) (optional)

   END

4. Parameter card (required)

CHEMICAL NUTRIENT LOADING PROGRAM INPUT FORM

1. SETUP CARD (REQUIRED)

START DATE (YYMMDD) (1)	STOP DATE (YYMMDD) (8)	SUB-TOTAL FREQUENCY (15)	R (23)	A (25)

cc 15-22: Sub-total Frequency (Left adjusted)
- YEARLY: Sub-totals at end of each year.
- MONTHLY: Sub-totals at end of each month.
- NN: Sub-totals at end of NN days (integer).

cc 23: R: Option to replace certain hydrological-discharge data from E034 input tape.

cc 25: A: Option to input additional daily hydrological-discharge data via input cards in addition to magnetic tape.
O: Option to input daily hydrological-discharge data via input cards instead of from magnetic tape.

2. HYDROLOGY DISCHARGE DATA REPLACEMENT CARD (OPTIONAL)

HYDROLOGY STATION (1)	DATE (YYMMDD) (10)	NEW VALUE (17–21)

HYDROLOGY STATION (1)	DATE (YYMMDD) (10)	NEW VALUE (17–21)

Maximum of 50 cards may be input.

Cards must be in ascending order of hydrology station (1-8) and date (10-15).

Last card must be end (1-3).

3. ADDITIONAL HYDROLOGY-DISCHARGE DATA CARD (OPTIONAL)

Values must be integer, right-adjusted
(All three cards must be input per station)
(Last card must be end (1-3))

1		10	12	14	16	22	28	34	40	46	52	58	64	70	80
TY	STATION NUMBER	YR	MO	1	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	DAY 8	DAY 9	DAY 10	
TY	STATION NUMBER	YR	MO	2	DAY 11	DAY 12	DAY 13	DAY 14	DAY 15	DAY 16	DAY 17	DAY 18	DAY 19	DAY 20	
TY	STATION NUMBER	YR	MO	3	DAY 21	DAY 22	DAY 23	DAY 24	DAY 25	DAY 26	DAY 27	DAY 28	DAY 29	DAY 30	DAY 31

	10	12	14	16	22	28	34	40	46	52	58	64	70	80
STATION NUMBER	YR	MO	1	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	DAY 8	DAY 9	DAY 10	
TY STATION NUMBER	YR	MO	2	DAY 11	DAY 12	DAY 13	DAY 14	DAY 15	DAY 16	DAY 17	DAY 18	DAY 19	DAY 20	
TY STATION NUMBER	YR	MO	3	DAY 21	DAY 22	DAY 23	DAY 24	DAY 25	DAY 26	DAY 27	DAY 28	DAY 29	DAY 30	DAY 31

END

1. PARAMETER CARD (REQUIRED)

	5	14	23	32	35	44	47	56	59	68	71	80
PROJECT CODE	CHEM STATION ID	HYDROLOGY STATION - 1	HYDROLOGY STATION - 2	PARM 1	CONVERSION FACTOR-1	PARM 2	CONVERSION FACTOR-2	PARM 3	CONVERSION FACTOR-3	PARM 4	CONVERSION FACTOR-4	CN